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NORTHWEST MONTANA WILDLIFE HABITAT ENHANCEMENT: HUNGRY HORSE ELK MITIGATION PROJECT

Monitoring and Evaluation Plan
December 1990

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EXECUTIVE SUMMARY

Beginning in September 1987, Bonneville Power Administration (BPA) funded an elk / mule deer winter range enhancement project adjacent to Hungry Horse Reservoir. The advance design phase of this enhancement project included collection of baseline population and vegetation data, habitat mapping, and detailed literature review. The contract also called for the preparation of a short-term plan to govern enhancement activities during the period 1988-1990, and a long-term implementation plan by December 1989. The final product of the advance design phase would be a detailed Monitoring and Evaluation Plan.

Two elk / mule deer winter ranges adjacent to (east of) the reservoir were selected as having potential for enhancement. These were the Firefighter Mountain winter range (Firefighter), near the dam, and the Spotted Bear winter range (Spotted Bear) at the head of the reservoir. Firefighter was selected as providing the greatest opportunity for enhancement, due to limited quantity and quality of winter forage. A long-term enhancement plan was submitted to BPA in June 1990. That plan identified 71habitat enhancement sites (67 at Firefighter, 4 at Spotted Bear). These included 13 sites in natural shrubfields, 6 sites where understory shrubs will be slashed, and 52 sites where some level of canopy removal will be used to create foraging areas. Enhancement activities will be funded through a trust fund agreement between FWP and BPA. An Advisory Committee made up of representatives of the involved agencies and other regional interests will provide advice and guidance to the Department in the design and implementation of mitigation projects.

Initial analysis of baseline data indicates that the Firefighter winter range is inhabited by approximately 180 elk, most of which are resident animals. Two primary herd units were identified. Pellet-group and browse-utilization transect data indicated low levels of elk use at random sites on Firefighter Mountain. Proposed treatment sites in natural shrubfields received more use. Forage condition was poor throughout the winter range, and preferred browse species such as serviceberry, maple and redstem ceanothus comprised less than 15 percent of the available shrub forage. Radio-marked elk occurred only sporadically in the extensively forested "greenslope" of seral lodgepole at the south end of Firefighter Mountain.

Preliminary population data from Firefighter indicate that a larger sample of marked animals (45 elk, or 25 % of the population), and more frequent aerial surveys will be needed to provide desired levels of accuracy during monitoring and evaluation efforts. Overall observability values for fixed-wing and helicopter surveys averaged 8 and 42 percent, respectively, for Firefighter, and 35 and 50 percent for Spotted Bear.

Sightability of marked elk (groups) was strongly influenced by canopy coverage at Firefighter, being highest (60%) in areas with 0-5% canopy cover. Sightability dropped to just 6% in areas with 50-75% canopy cover, Because most

of Firefighter is forested, the relationship between group size and sightability was less clearly defined. Sightability averaged 13% for all groups, ranging from 0% for single elk to 100% for groups of >15, and varying from 33 to 67% for groups of 2-6 animals, Sightability was also analyzed for winter range segments, and varied from 0 to 23%. Increased sample size during monitoring and evaluation should clarify these relationships. We hope to build a sightability model for Firefighter and Spotted Bear using fixed-wing aircraft. More frequent helicopter surveys will probably be necessary, however, if the use of marked animals is to be de-emphasized. Sightability analysis of Spotted Bear data was not completed for this report,

Initial population estimates for Spotted Bear indicate a wintering population of approximately 600 elk north of the Spotted Bear River. Preferred browse species are more abundant than at Firefighter. Elk-use indices for random sites averagedwell above those for Firefighter. Proposed treatment sites received the greatest use based on pellet-group densities. Data collection and analysis for the Spotted Bear winter range was de-emphasized as Firefighter became the focus of enhancement efforts.

Pellet-group and browse utilization transects will continue to be used to evaluate elk use of treatment sites and control areas. A tentative sampling scheme combining these techniques and ECODATA techniques was designed for assessing habitat and animal response to treatments. A set of 32 ECODATA plots will be used to compare treatment types, pre- and post-treatment conditions, and within-treatment variation in habitat enhancement success.

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INTRODUCTION

Portions of two important elk (Cervus elaphus) winter ranges totalling 8,749 acres were lost due to the construction of the Hungry Horse Dam hydroelectric facility (Casey et al. 1984). This habitat loss decreased the carrying capacity of these winter ranges by an estimated 175 elk, and the loss of 3,844 acres of upland shrub habitat on these winter ranges was also responsible for lowering the carrying capacity for mule deer (Odocoileus hemionus) (Casey et al. 1984). In 1985, using funds from the Bonneville Power Administration (BPA) as authorized by the Northwest Power Act, the Montana Department of Fish, Wildlife and Parks (FWP) completed a wildlife mitigation plan for Hungry Horse Reservoir (Bissell and Yde 1985). This plan identified habitat enhancement on currently-occupied winter range as the most cost-efficient, easily implemented mitigation alternative available to address these large-scale losses of winter range. The Columbia Basin Fish and Wildlife Program, as amended in 1987, authorized BPA to fund winter range enhancement to meet an adjusted goal of 133 additional elk.

A 28-month advance design phase of the BPA-funded project was initiated in September 1987. Primary goals of this phase of the project included detailed literature review, identification of enhancement areas, baseline (elk population and habitat) data collection, and preparation of 3-year (Casey et al. 1988) and lo-year (Casey and Malta 1990) implementation plans. These plans outlined the design and implementation schedules for habitat treatments and associated monitoring to be conducted jointly by FWP and the USDA Forest Service (USFS) during the period 1989 - 1996. This document will serve as a site-specific habitat and population monitoring plan which outlines our recommendations for evaluating the results of enhancement efforts against mitigation goals.

This enhancement project is based on the assumption that poor interspersion of cover and forage, and a deteriorating forage base (due to fire suppression and subsequent stagnation and conifer encroachment) continue to limit the elk and deer populations adjacent to the reservoir. Quantity and quality of winter range, particularly the interspersion of cover and forage, are typically assumed to control the size, dynamics, distribution and productivity of big game populations. Transitional habitats (those used during late fall and late winter) are also considered to be extremely important, for it is the condition in which an animal enters winter, and its condition immediately before parturition, which effect winter mortality and natality, respectively (Cheatum and Severinghaus 1950, Taber et al. 1982).

The scope and objectives of the project directly address the management concerns for elk and mule deer in FWP administrative Region 1 (Mussehl et al. 1986), and for big game winter range management on the Hungry Horse and Spotted Bear Ranger Districts of the Flathead National Forest. Public ownership of key habitats, consideration of habitats as land uses intensify, and provision of a diversity of hunting opportunities are all designated as important regional FWP concerns.

Areas selected for enhancement are located on lands managed as big game winter range by the Forest Service. Project goals are consistent with USFS stated goals (USDA Forest Service 1985) of maintaining suitable ratios of forage and cover in these areas.

The primary responsibilities of the FWP project personnel have been to develop and implement the population and habitat monitoring effort. Enhancement activities are being conducted by personnel employed by or under contract with the Flathead National Forest, either through separate contract(s) with BPA, or through the earnings of the wildlife mitigation trust fund. Coordination, planning, and preparation of environmental documentation relating to long-term enhancement activities were facilitated through regular meetings of the Hungry Horse Interdisciplinary (ID) Team. This team consisted of wildlife, timber, and planning specialists from both FWP and USFS. The ID Team approach is used to implement the Forest Plan at the Ranger District level.

Historical data summarized by Casey et al. (1984) indicated that elk populations have fluctuated between 1000-1500 in the valley of the South Fork Flathead River (South Fork) outside the wilderness, with the majority wintering on Dry Parks (Biggins 1975). Prior to this study, estimates based on annual surveys (FWP file data) indicated a current population of 500 - 1000 at Spotted Bear, and 50-100 on and around Firefighter Mountain. Based on the habitat condition and status of the population, the Firefighter Mountain winter range was selected for the primary emphasis of the short-term enhancement activities (Casey et al. 1988).

A small population of mule deer winters in the South Fork; one of the few pre-dam estimates listed the population at 375 (Rognrud 1949). Few are recorded during annual aerial surveys of the two winter ranges in the project area (Cross, pers. comnl.). The deer tend to use the higher portions of the winter range, along exposed ridges, moving into lower areas as spring green-up progresses.

STUDY AREA(S)

Firefighter. Two big game winter ranges adjacent to Hungry Horse Reservoir were selected for initial enhancement activities. The Firefighter Mountain winter range (Firefighter) is on the northeast end of the reservoir (Fig. 1). As defined for this project, this winter range comprises approximately 28,160 acres, though enhancement activities were limited to an area approximately 7000 acres in size in the core of the winter range.

Though dominated by fire-caused shrubfields when the dam was built, the Firefighter area is now primarily forested, as conifers have gradually encroached into the openings. Today, natural open areas on Firefighter are typically less than 30 acres in size.

The Flathead Forest Plan (USDA Forest Service 1985) designated approximately half of Firefighter as Management Area (MA) 13 (and 13A), elk and mule deer

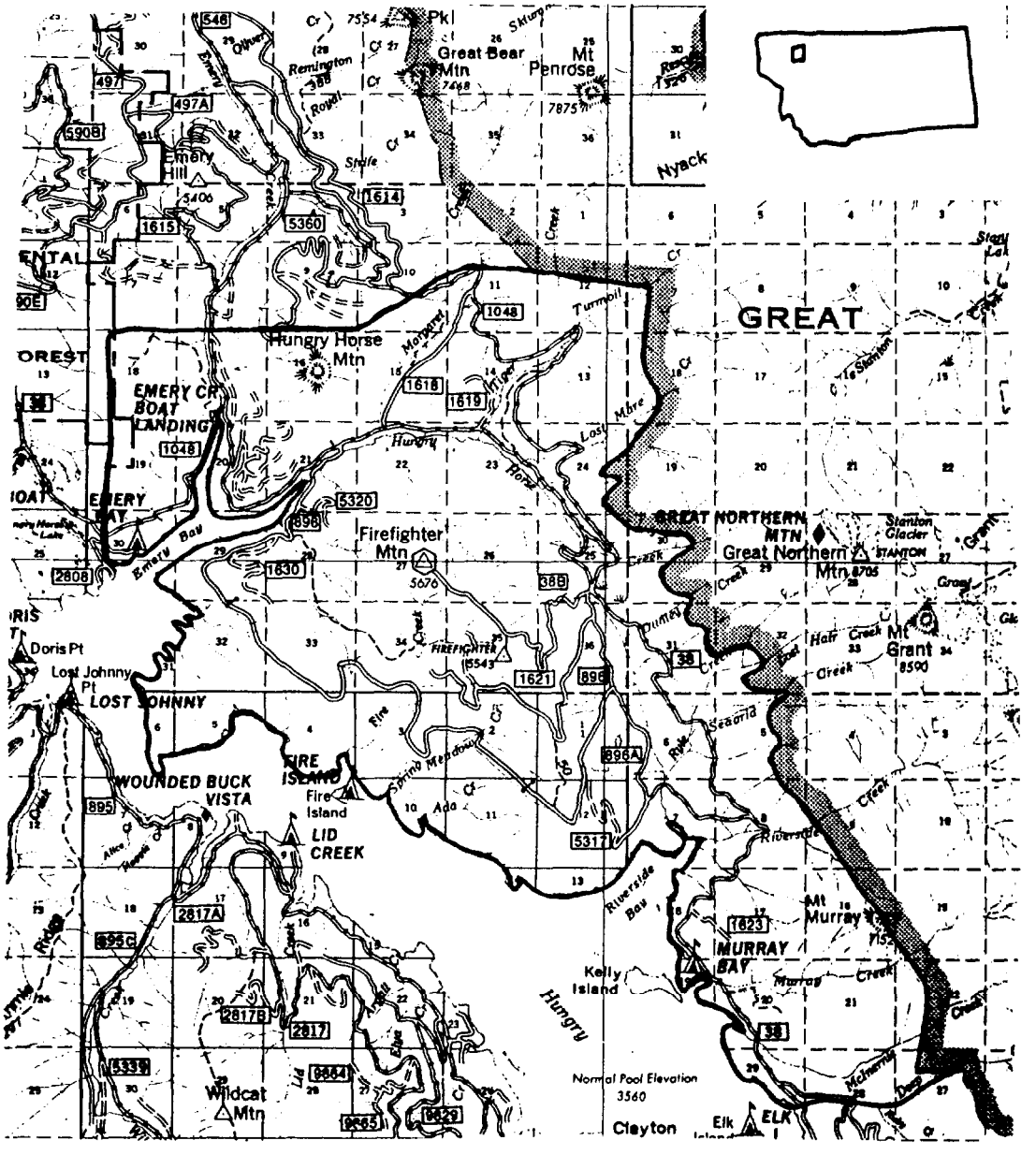


Figure 1. Map of the Firefighter Mountain winter range, adjacent to Hungry Horse Reservoir, northwest Montana.

winter range. The other half consists mostly of areas designated as MA 15 (cost-efficient timber production emphasis) and MA 16 (timber production without roads). The remainder of the area is designated as MA 7 (visual quality emphasis). Each MA (except 13A) has a designated timber harvest yield and therefore includes some level of timber management, depending on resource emphasis. The emphasis in MA 13 is to provide size, age, diversity and distribution of cover and forage areas suitable for elk and mule deer winter habitat.

Spotted Bear. The Dry Parks / Spotted Bear winter range (Spotted Bear) lies at the southeast end of Hungry Horse Reservoir, and encompasses a portion of the South Fork drainage above the reservoir, as well as the lower portion of the Spotted Bear River drainage (Fig. 2). As defined for this study, the winter range is bounded on the west by the reservoir and the South Fork; on the east and south by wilderness boundaries, comprising approximately 70 square miles.

The southern portion of the Spotted Bear winter range is primarily forested. The Dry Parks area, on the other hand, is dominated by fairly steep western exposures with very large shrubland areas interspersed with smaller patches of timbered habitat. Spotted Bear contains proportions of MA'S similar to Firefighter; the majority of land designated MA 13 at Spotted Bear'(Dry Parks) is non-forested.

PROJECT GOALS AND OBJECTIVES

The primary goal of the project is to increase elk carrying capacity in currently occupied winter range areas through habitat enhancement. Specific goals include creation of foraging habitat (openings of <=20 acres) in areas where natural succession led to skewed cover/forage ratios; and rejuvenation of existing, shrub-dominated openings through prescribed burning. We hope to increase habitat quality / availability for mule deer by incorporating their habitat needs into the design of habitat treatments planned primarily for elk, (e.g. providing additional spring range areas through the creation, treatment or expansion of openings).

An additional, essential project goal is to design and implement an intensive populationmonitoringprogramwhichwillallow assessment of population responses to habitat treatment. Specifically, we need to determine bounded estimates of baseline elk and mule deer populations using the two winter ranges; design and implement surveys to monitor populations through estimation of population size and dynamics; determine baseline patterns of distribution within winter ranges; design and implement surveys to document changes in distribution over time; determine baseline and post-treatment patterns in habitat use and food habits; design and implement systematic surveys to monitor changes in habitat use.

The primary goal of our habitat monitoring program is to describe baseline habitat condition, and design and implement a habitat monitoring system which

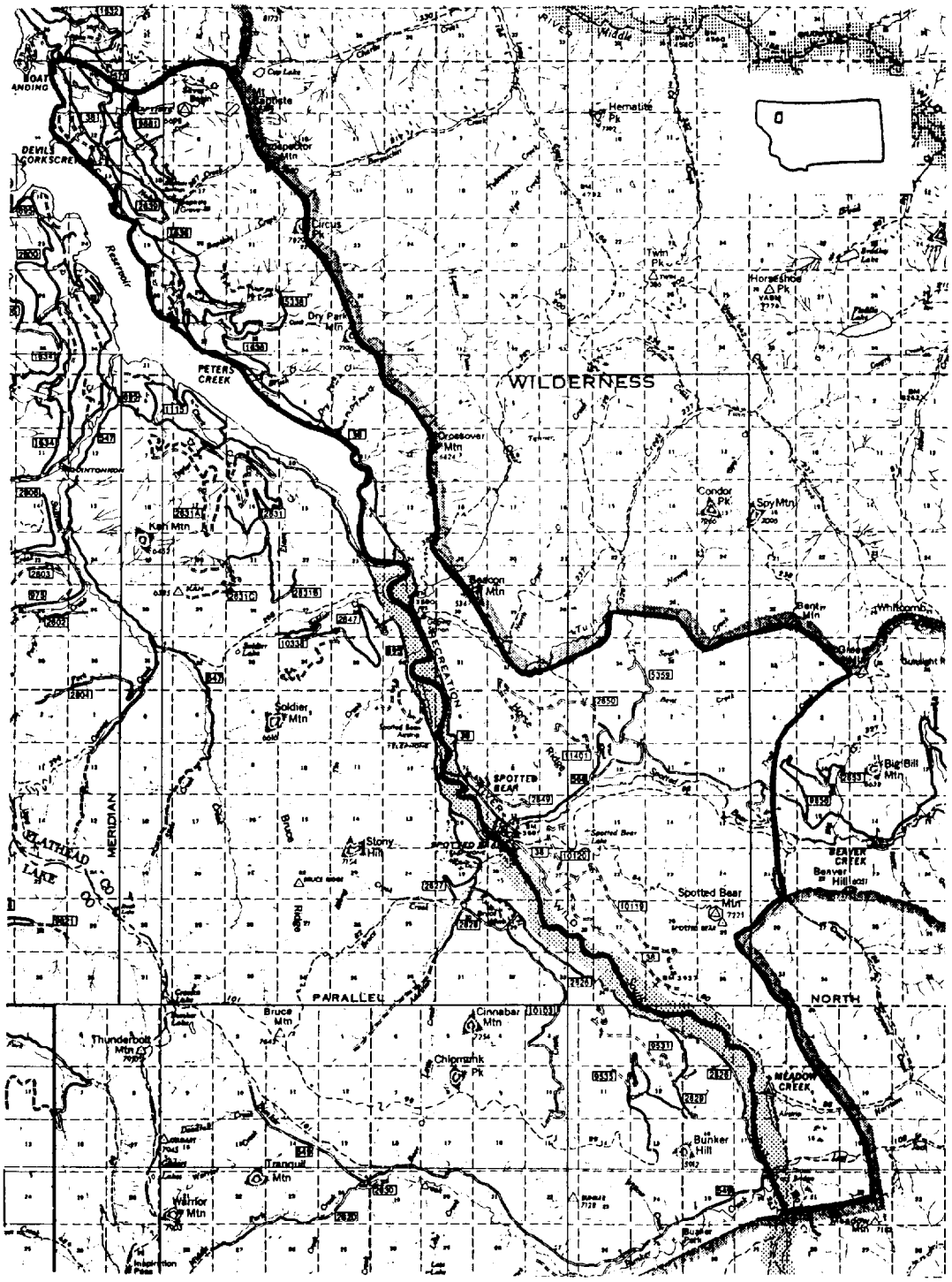


Figure 2. Map of the Spotted Bear winter range, adjacent to Hungry Horse Reservoir, northwest Montana.

allows determination of habitat responses to treatment. We will calculate baseline and post-treatment habitat effectiveness, based on road density, cover/forage ratio, and habitat distribution within each winter range. Site-specific monitoring goals are to determine species composition, density, cover values of dominant and subdominant plant species, and forage production in treatment areas, before and after treatment.

This report includes brief summaries of the methods, study design and results of project activities as of 31 October 1990. More detailed descriptions are included in our annual project report for FY90 (Casey and Malta 1990b). Planning efforts, data collection, and analysis to date have focused primarily on the Firefighter area, where the majority of enhancement activities are to take place. The monitoring and evaluation of habitats and elk populations at Firefighter are the focus of this plan.

METHODS - ADVANCE DESIGN PHASE

Population Monitoring

Baseline population and habitat data collection was begun during late fall, 1987. Radio-marked elk were used to determine current distribution and seasonal use patterns. Population monitoring concentrated on establishing baseline information, and on testing methods for assessing response to pilot habitat treatments. Ultimately, we plan to determine and maintain a marked sample size adequate for determining a 95 % confidence interval of 10 % around our population estimates (Rice and Harder 1977). The original estimate of 25% observability for fixed-wing surveys of this herd, developed by Biggins (1975), was tested using a double aerial sampling scheme similar to that developed in Idaho by Samuel et al. (1987). This method assesses observability (sightability) as a function of group size, canopy coverage, and other factors (Samuel et al. 1987).

Trapping. Elk were captured using modified Clover traps (Clover 1956, Thompson et al. 1989). Trapsites were selected based on historic and current elk distribution data, field reconnaissance, elk response to pre-baiting, and ease of access. Fourteen sites were used at Firefighter during the three winters (Appendix A). These were distributed so as to identify baseline distribution for various herd segments within the winter range.

Seven (Clover) trapsites were used at Spotted Bear during the three trapping seasons (Appendix B). A corral-trap was built at Spotted Bear for the 1989/90 trapping season. The Dry Parks, Horse Ridge and Crossover trapsites (Appendix B) were approximately the same sites used by previous researchers (Biggins 1975).

Sex of trapped animals was determined by the presence/absence of antlers and/or inspection of the genitals. Age was estimated from tooth (primarily incisor) eruption and wear (Quimby and Gaab 1957).

Elk were marked with standard, single-pulse radio-transmitter collars. Radiocollars were also equipped with color-marked neckband material for individual recognition. Similar neckbands were put on elk which did not receive radiocollars. All marked elk were also marked with large yellow stock-tags in each ear to increase observability. These were individually numbered as a further means to identify individual animals (particularly mortalities).

Population Surveys. We attempted to conduct aerial surveys of both winter range areas at least twice monthly during Sept.-May, and at least monthly during the summer. At least two surveys each year were conducted by helicopter. Surveys were coordinated with ongoing regional surveys, to maximize data-sharing and efficiency in data collection. During each survey, we recorded the location, number and general habitat type of each elk or group of elk. Visual confirmation of radio-collared animal locations, and classification (age/sex) data were collected whenever possible, and all relocations were mapped on mylar-coated orthographic aerial photos or topographic maps of the area. Population indices

were calculated almost entirely from aerial survey data, though sign survey data were also used to indicate trends.

Long term trends in distribution and habitat use by elk and deer will be monitored within and around the treatment areas, particularly to determine if increased use indicates an actual population increase or merely a shift in distribution. The locations of all elk and mule deer (groups) seen within the project area were mapped to describe current seasonal distribution and habitat use patterns within each winter range. Composite maps of the number of elk group locations by UTM coordinate were developed for Firefighter, to display seasonal patterns in distribution. For these maps, a location was defined as an elk group of any size, located either visually or by radiolocation. Hence a single, unmarked elk was weighted equally with a group of 10 elk including three marked animals. This removed part of the bias caused by low sightability and interactions of marked animals. Seasonal home ranges of radioed elk were mapped from relocation data. Calving areas and other important seasonal use areas were identified through plotting of digitized radiolocation data, and through the seasonal elk group density maps.

Mark-recapture estimates (Rice and Harder 1977) were developed for each winter range (and for winter range segments at Firefighter) using the aerial survey data, A recapture was defined as a visual relocation of a marked animal. Mark-recapture estimates were developed for each aerial survey using the ratio of marked animals seen and total elk seen during the survey, by winter range segment (herd unit). Adjustments were made for marked animals known to be outside the area intensively surveyed, and for known emigration and mortality. Summed mark-recapture estimates were also developed for individual winter range segments. Only those elk groups seen without the aid of the radio receiver (see below) were used to calculate mark-recapture estimates.

Aerial surveys conducted during winter (15 Dec. - 15 May) were designed to provide data which could be used to develop a sightability model, based on that described by Samuel, et al. (1987). Two complete passes over the winter range were conducted during each such flight. The radio receiver was not used during the first pass, and all elk seen were classified (when possible) and counted. General canopy coverage class (O-5, 5-25, 25-50, 50-75, 75-95, 95-100 percent), group size, and activity were noted for each group. Any marked animals seen during the first pass were noted, and individually identified when possible. During the second pass, we searched for radios using a receiver, recording all data as described for the first pass. Sightability values were then calculated by dividing the number of groups containing radio-marked animals, which were seen during the first pass, by the total number of groups containing radio-marked animals which were present in the survey area.

Data from double-sampling surveys was used to develop sightability curves (models) based **on** canopy coverage and group size, for each winter range segment (herd unit). These data also provided an opportunity to calculate mark-recapture estimates free of the bias caused by observing animals, which otherwise might

have been missed, during intensive efforts to see marked (radio-collared) animals.

All animals seen during aerial and ground surveys were classified by age class and sex. Population age structure was also determined through examination of trapped animals and the collection of teeth at hunter check stations.

Pellet-Group Transects. Habitat conditions and elk use patterns during the winters of 1987/88 and 1988/89 were determined in part through the use of pellet-group / browse utilization transects. Loft and Kie (1989) showed that pellet-group transects accurately reflect deer habitat use during seasonal use periods, This effort served as a pilot study to determine the number of transects necessary to adequately describe habitat use. Because of the large number of transects needed to accurately estimate population size based on pellet-group data (Neff 1968), population estimation was not an objective. Cursory estimates were developed for comparison to aerial survey data.

Pellet-group transects were established in proposed treatment sites and at a set of random locations stratified by elevation, aspect and canopy coverage class (Casey and Malta 1990b). Such stratification allowed for analysis of pellet group (elk) densities based on these variables, for use in future planning efforts. Transects were 250 mlong, with starting points permanently marked. All pellet groups within 2 m on either side of the center line were counted and cleared. Total area sampled on each transect was 1000 sq m, or 0.1 ha (0.25 acres). The approximate age, and species were recorded for each pellet group. We defined winter as the period 15 Dec. - 15 May. Only those groups classified as "new", "moderately new" or "fresh" (if prior to 15 May) were used to calculate elk and deer-use estimates. Through such classification and clearing the transects, we hoped to reduce the error due to mis-classification of pellet-group age (Van Etten and Bennett 1965).

Sixty potential (random) transect sites were selected in the Firefighter winter range, and 18 of these were sampled in 1988 (Appendix C). Eleven of these and 12 additional sites were sampled at Firefighter in 1989 (Appendix C). These included 8 proposed treatment sites, three of which had been sampled in 1988. Sixteen of 47 potential random sites were sampled at Spotted Bear during 1988 (Appendix D). The 4 treatment sites were sampled there in 1989 (Appendix D), and all 16 random sites sampled in 1988 were re-sampled.

Mule Deer

Sex and age of all mule deer captured incidental to elk trapping efforts were recorded. Females were marked with neckbands coded for individual identification. The location, number, sex and age class of all marked and unmarked mule deer seen during aerial surveys were recorded. Distribution, habitat use, and relative abundance of mule deer were also assessed by recording all deer pellet groups encountered on pellet-group transects.

Vegetation Monitoring

The habitat monitoring effort consists of two phases: documentation of baseline and changing habitat distribution, and documentation of specific vegetative response to treatment.

Early in the advance design phase of the project, a baseline elk habitat map of each winter range was drafted, based on the USFS Geographic Information System (GIS), forest types (Pfister et al. 1977), review of orthophotos, and ground-truthing, Habitat effectiveness ratings (Lyon 1979) were calculated for specific areas containing enhancement sites (USDA Forest Service 1990).

Browse Transects. Browse utilization transects were based on methods described by Cole (1959) and Stickney (1966), and were conducted at a subset of the randomly-selected pellet-group transect locations. The first 125 m along each transect was sampled. The closest shrub perpendicular to the line was recorded at 5-m intervals, so that measurements were taken for 50 shrubs on each transect. Measurements taken at each shrub included distance from the line, height and width (to the nearest 5 cm), and number of browsed/unbrowsed twigs within a random cluster picked within the estimated reach of elk (>0.5m and <2m above the ground). These data provided estimates of shrub density, relative abundance, and vigor, as well as utilization. In addition, the lengths of up to 5 browsed and 5 unbrowsed twigs (current annual growth) were measured at each of 25 shrubs on alternating sides of each transect. This allowed calculation of browse utilization based on both % of twigs browsed (Stickney 1966), and length of twigs browsed (Aldous 1944).

Browse transects were sampled at 13 stratified random sites and one proposed treatment site at Firefighter during 1988. Three random sites and 7 treatment sites were sampled in 1989 (Appendix E). Sixteen random sites were sampled at Spotted Bear during 1988, and the four proposed treatment sites along the Dry Parks section of Spotted Bear were sampled in 1989 (Appendix F).

ECODATA Plots. ECODATA plots (ECODATA, USDA Forest Service Handbook) were conducted at each of two proposed treatment sites at Firefighter during 1989. We used the ocular plot method, which provides a fairly detailed description of the vegetative features of a plot, particularly indicator and dominant plant species. Data collected included a complete species list, stand structure, distribution within the plot by size class and phenology, estimated canopy cover, and shrub form class. Additional vegetation sampling was postponed until treatment locations and configurations were finalized (i.e. implementation of the long-term plan).

RESULTS AND DISCUSSION

Data collected and analyzed during the advance design portion of the project fall into two basic categories: 1) data descriptive of baseline elk populations and habitat conditions, and 2) data relative to the success and applicability of field methods. Those data which had the most bearing on the design of the proposed monitoring and evaluation plan are reported here. Additional summaries were provided in our annual report (Casey and Malta 1990b).

Population Baseline Data

Trapping. Our 3-yr effort of 418 trap-nights (t-n) resulted in 93 captures of 84 individual elk (9 recaptures), 27 captures of 23 individual mule deer (4 recaptures), and 1 moose (*Alces alces*) capture (Casey and Malta 1990b). We marked a total of 69 elk and 12 mule deer.

Firefighter. Three trapsites (Firefighter NW, Hungry Horse Mountain and Hungry Horse II) yielded 26 of 45 captures (58%) within the Firefighter winter range (Appendix G), and will therefore continue to be used for marking efforts. Additional sites which yielded no captures (Casey and Malta 1990b) will no longer be used, unless concentrated elk use of those areas is noted,

At Firefighter, trapping success was highest during February (5.3 t-n/elk) in 1987/88, April (2.5 t-n/elk) in 1988/89, and April again in 1989/90 (1.0 t-n/elk). Overall trapping success with Clover traps averaged 6.7 t-n/elk for three trapping seasons at Firefighter.

A total of 32 elk were marked at Firefighter during the report period (22 radiocollars, 10 neckbands); 28 marked animals remained in the population as of October 1990. The age/sex distribution of marked animals in the Firefighter population (as of Sept. 1990) was 5 males (2 yearlings, 3 branch-antlered bulls (BAB)), and 25 females (2 yearlings, 23 adults). Cows in the 2.5 - 6.5 yr age class made up 46 % of the animals captured at Firefighter (Fig. 3); this age class was also most numerous in our total trapped sample.

Spotted Bear. Yearly peak trapping success with Clover traps at Spotted Bear were January 1988 (2.3 t-n/elk), March 1989 (4.0 t-n/elk), and January 1990 (2.4 t-n/elk). The corral trap at the Spotted Bear pole barn was most successful during March 1990, when 20 elk were caught during 6 trap-nights (0.3 t-n/elk).

A total of 37 elk were marked at Spotted Bear during the report period (17 radiocollars, 20 neckbands). Four hunter kills and 3 natural mortalities left 30 marked animals in the population as of October 1990. These included 3 bulls (1 yearling, 2 BAB), and 28 cows (2 yearlings, 26 adults).

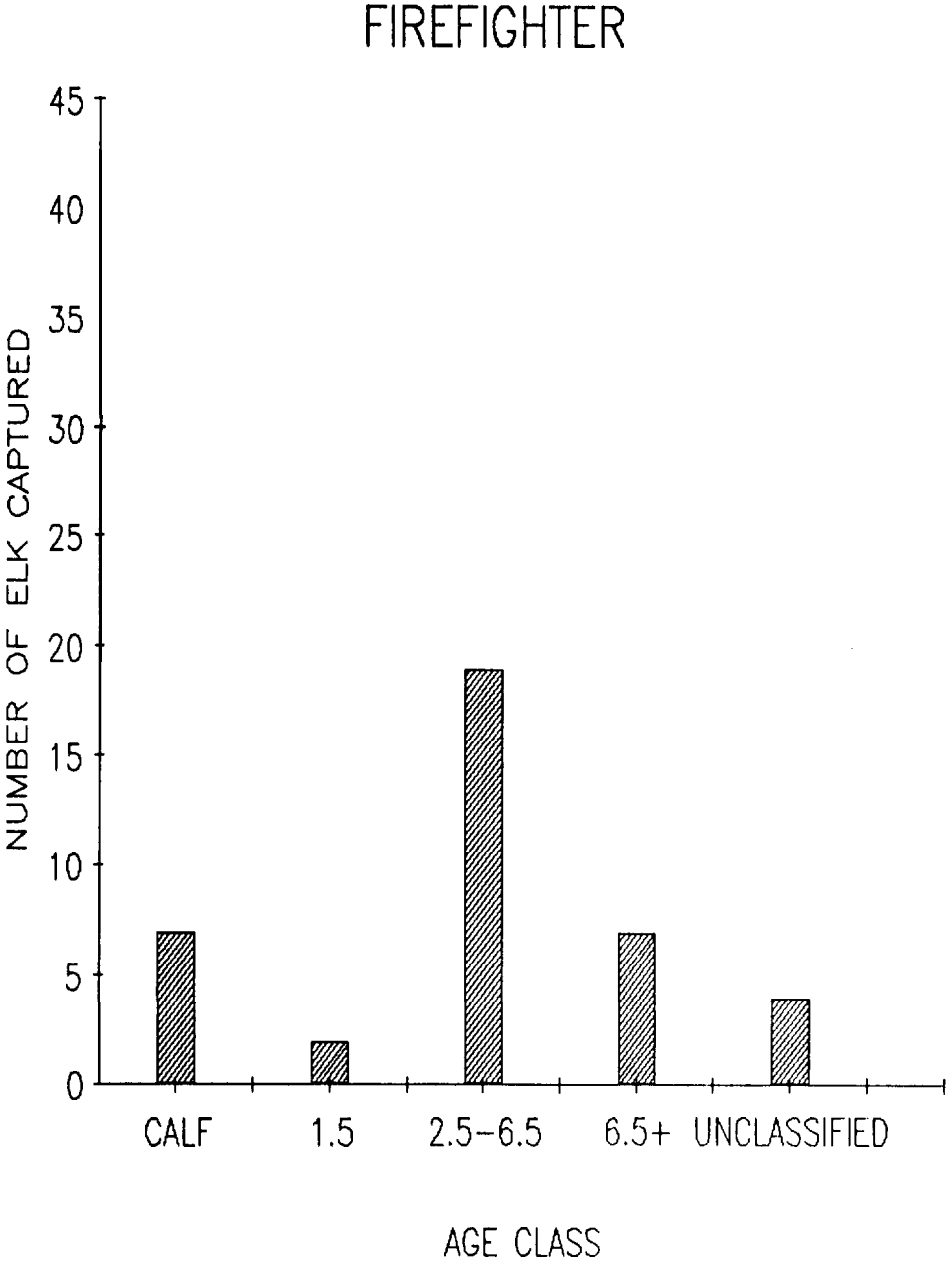


Figure 3. Age class distribution of trapped elk, Firefighter Mountain winter range, 1988-1990.

Population Surveys

Distribution - Firefighter. Two distinct herd units were identified in the Firefighter Mountain winter range area. Elk marked at trapsites at the north end of Firefighter Mountain and Hungry Horse Mountain utilized most of both mountains, ranging from the Emery Creek drainage (Emery Hill) south to Dudley Creek (Appendix H). Only two elk marked in this herd unit were found south of Riverside Creek. Elk marked at the Deep Creek and Elk Island Overlook trapsites ranged north only as far as Riverside Creek, and south to Canyon Creek (Appendix H).

Cumulative radio-locations for all marked elk at Firefighter indicated that the northwestern portion of Firefighter Mountain, and the SE-aspect of Hungry Horse Mountain receive the greatest amount of year-round use by elk (Fig. 4). Elk radio-locations on Firefighter Mountain were generally clustered on SW aspects, in that portion of the area with the greatest habitat diversity (natural openings, potential old growth stands). Fewer locations were recorded in the southeastern portion of the mountain, which is dominated more by dense seral lodgepole stands. Winter (15 Dec. -15 Apr.) radio-locations also followed this pattern, with the majority of locations on SW-facing lower slopes of Firefighter, SE-facing slopes of Hungry Horse Mountain, and Emery Hill (Fig. 5).

Marked elk distribution was apparently representative of overall distribution. Cumulative mapped group distribution within the Firefighter area also indicated a herd unit boundary at approximately Riverside Creek, and concentrated use of the northwest portion of Firefighter Mountain (Fig. 6). Group density mapping was useful for identifying seasonal shifts in overall elk distribution (Appendix I), and should serve as a useful monitoring tool as we enter the evaluation phase of the project.

All cows marked to date at Firefighter have apparently been resident animals. Compilation of digitized locations indicate that winter (15 Dec. - 15 May) home ranges are generally small, encompassing lower portions of northwestern Firefighter, and Hungry Horse Mountain (Fig. 7). Summer (16 May -14 Dec.) home ranges of individual marked elk did not generally differ greatly from winter home range areas (Fig. 7), though in some cases summer ranges were substantially larger (Fig. 8). Little variation was noted in the size and location of seasonal ranges of marked cows. Distribution of marked elk during spring, calving, summer and on through the end of the hunting season varied predictably by elevation within the Firefighter project area (Casey and Malta 1990b). A more detailed analysis of baseline home range data, using standardized home range software packages, will be included in our FY91 annual report.

Distribution - Spotted Bear. Preliminary data from Spotted Bear indicate that the winter herd units identified by Biggins (1975) are still readily apparent, with 4 fairly distinct herds centering roughly on the Dry Parks, Horse Ridge, Bent Creek, and Spotted Bear Mountain areas. Unlike Firefighter, most of these animals appear to be migratory, generally spending the period May - Nov. at

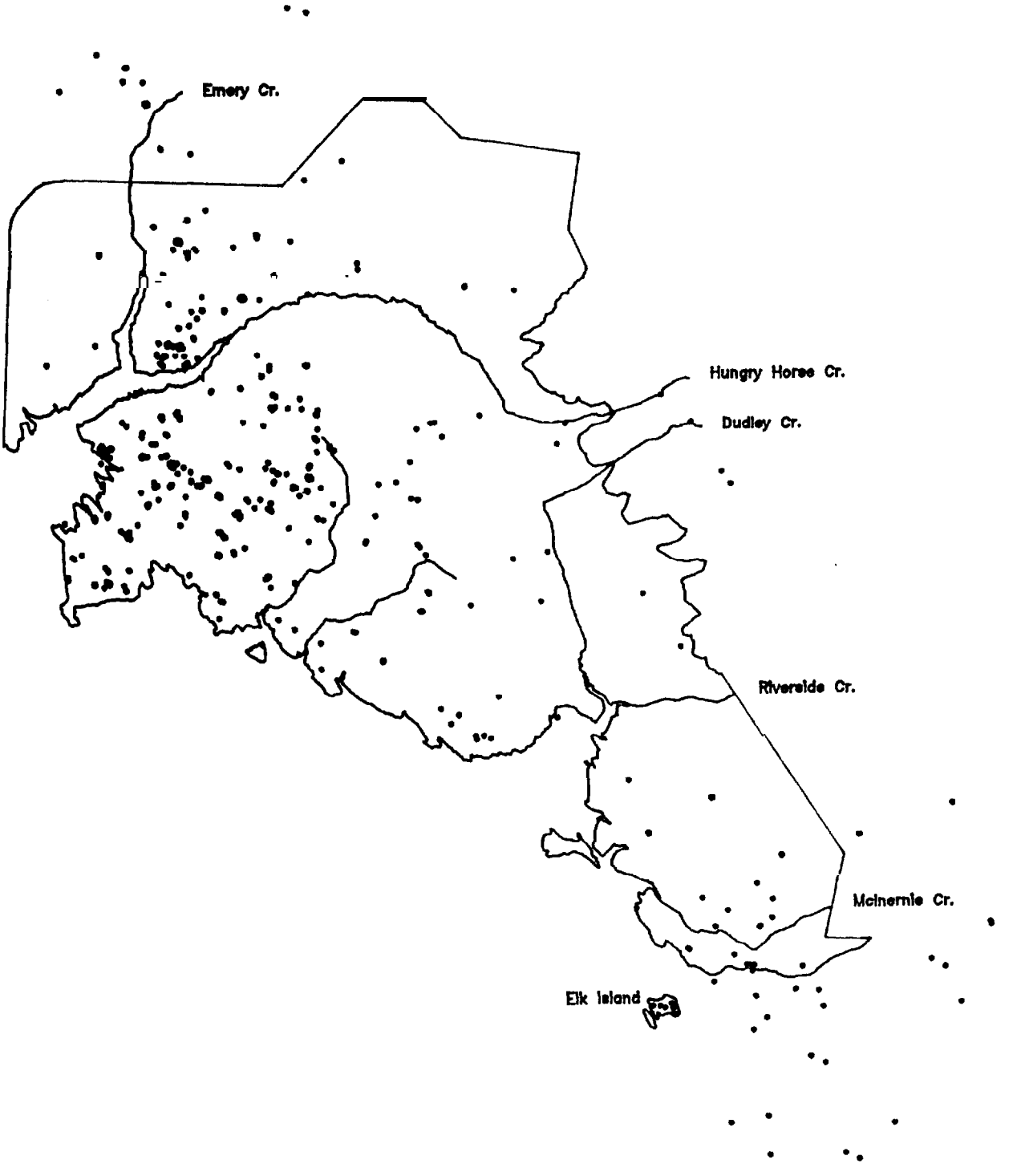


Figure 4. Cumulative radio-locations, January 1988 - 15 May 1990, for elk marked in the Firefighter Mountain winter range.

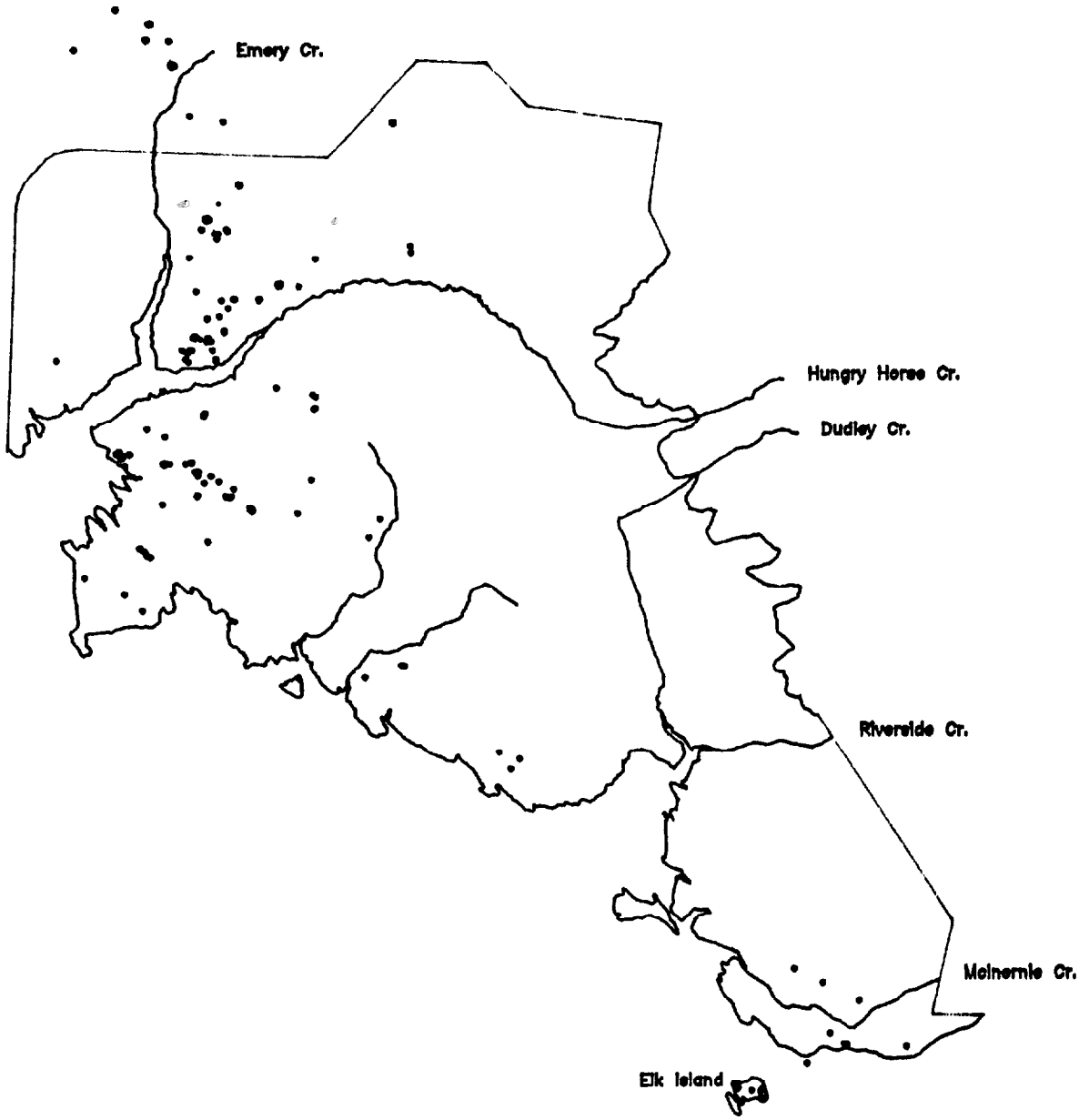


Figure 5. Winter (15 Dec. - 15 Apr.) radio-locations for elk marked in the Firefighter Mountain winter range.

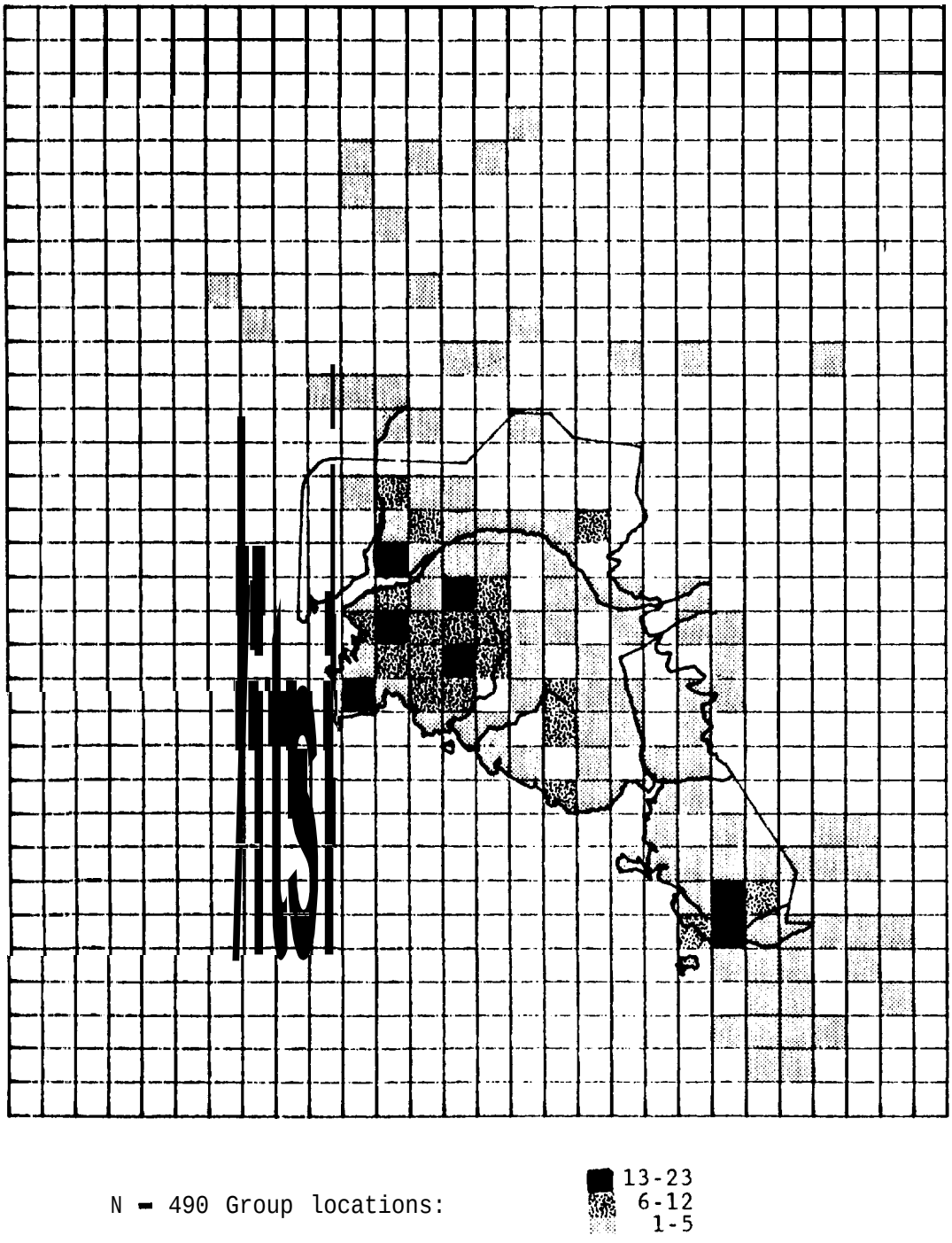


Figure 6. Density of elk group locations during aerial surveys, by UTM grid, Firefighter Mountain project area, 1987-1990.

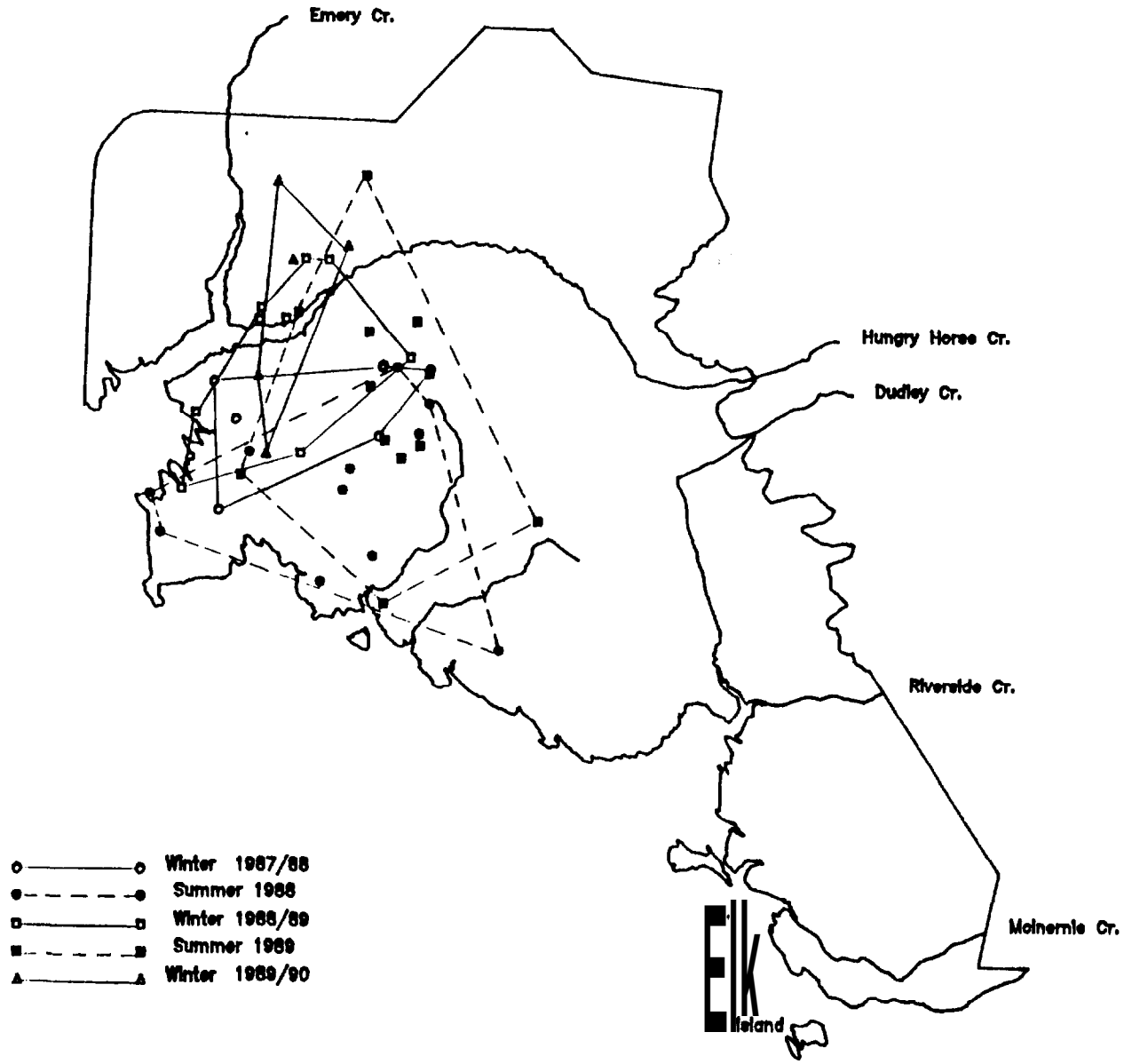


Figure 7. Representative seasonal home range map for cow elk (elk #05), Firefighter Mountain winter range area.

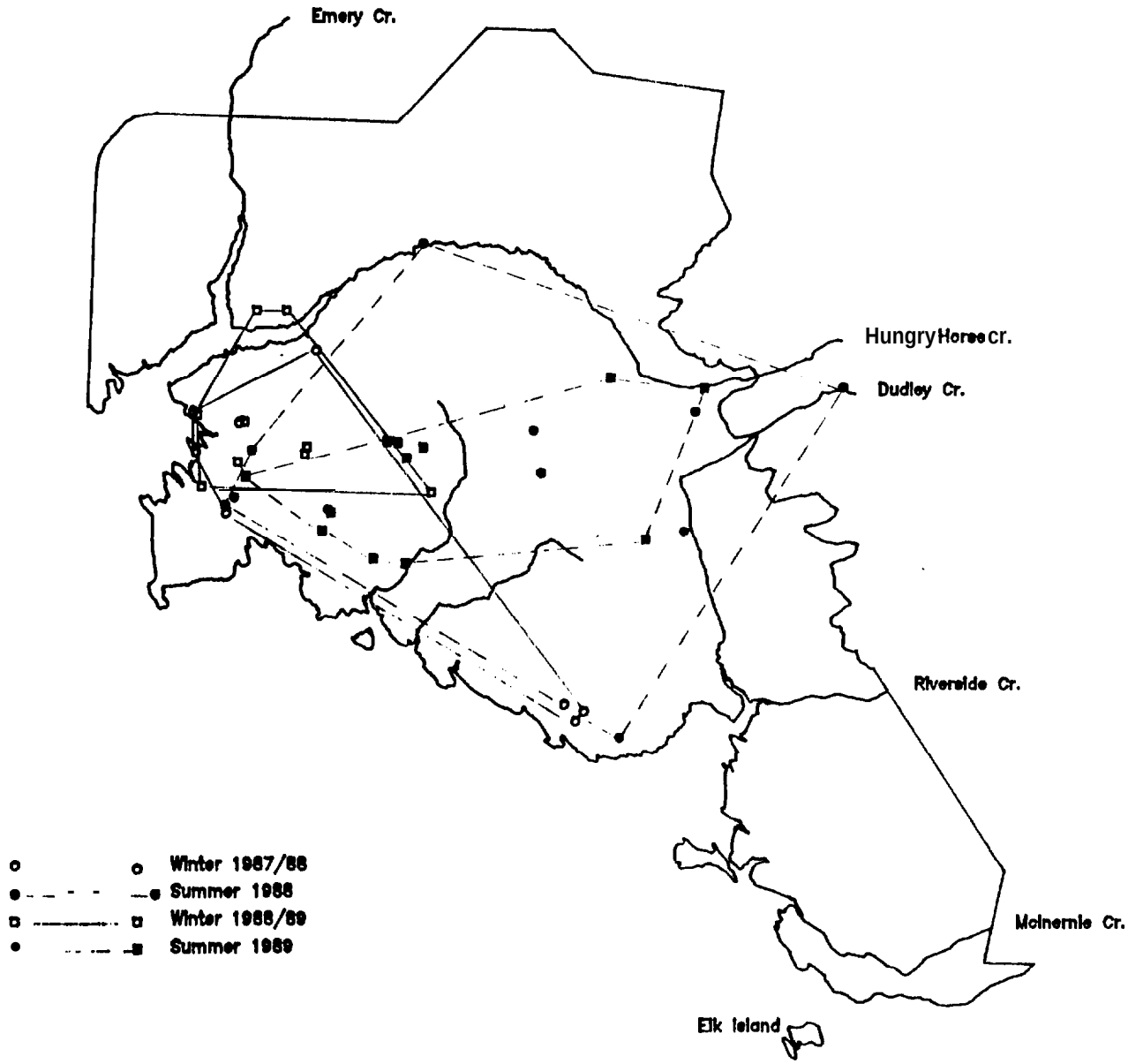


Figure 8. Representative seasonal home range map for cow elk (elk #02), Firefighter Mountain winter range area.

higher elevations in the Great Bear and Bob Marshall Wilderness Areas. The exception to this pattern is the resident Spotted Bear Mountain herd.

Mark-recapture Estimates. Mark-recapture estimates (Rice and Harder 1977) were developed from 10 double-sample and helicopter survey flights at Firefighter (Table 1). During 1987/88, we were able to mark only the population segment in the core area of Firefighter Mountain, so the estimates of 83-97 elk primarily represent that population segment. Survey efficiency and increased sample size allowed for an estimate (127 elk) more indicative of the entire population of the study area during 1988/89 (Table 1).

We had the widest distribution and greatest number of marked animals available for aerial surveys during the winter of 1989/90. Mark-recapture estimates for the entire Firefighter area averaged 186 elk (154-222), with 5 of 7 flights suitable for estimates (Table 1).

Baseline data were used to identify trends in distribution, important use areas, and herd unit boundaries. Preliminary population estimates derived through mark-recapture methods were reasonably consistent for both winter ranges, given the relatively small number of flights from which estimates could be derived. Results of these aerial survey data indicate we need to increase both the number of marked elk and the number of survey flights. Rice and Harder (1977) provided graphic illustrations of the relationship between proportion of the population marked (M/N), population size (N), and sample size (K) needed to provide given confidence intervals around population estimates, for given observability values. Our population estimates for Firefighter indicated a population of approximately 180 elk. Using the average observability value we calculated for helicopter surveys at Firefighter (42 %), and assuming we can increase our marked sample to about 45 animals (25% of the population), we would need approximately 12 aerial surveys of 60 or more elk to yield a 95% confidence interval of $\pm$ 0.1 N (about 18 animals). Just three flights with these same parameters would yield a 95% c.i. of $\pm$ 0.2 N (about 36 animals), according to formulas from Rice and Harder (1977). We recorded more than 60 elk on just two of 18 survey flights at Firefighter during the report period, one fixed-wing and one helicopter (Table 1).

Two mark-recapture estimates were developed for the Spotted Bear winter range area during 1987/1988 and 88/89, and three during winter 1989/90 (Table 2). No marked animals were seen during two other complete survey flights. There were no substantial increases in the number of marked animals available for survey during the three years, with the exception of the last flight in 1990. Population estimates averaged 371, 651, and 708 for the three winters, respectively. These estimates represent those segments of the population wintering north of the Spotted Bear River. Mark-recapture estimates could not be derived for Spotted Bear Mountain due to insufficient data. Although Spotted Bear Mountain supports a fairly large elk herd unit, dense canopy severely limited sightability.

Table 1. Aerial survey data, mark-recapture estimates of elk populations in the Firefighter Mountain winter range area, 1988-1990.

Year	Survey Date[a/]	Total Marked(M)[b/]	Total Seen(C)	Marked Animals Seen(R)	Observability (R/M)	Population Estimate(N)[c/]
1987/88	3/11	4	23	0	0.00	---
	3/18	6	24	0	0.17	87
	4/09	6	23	1	0.17	83
	4/16[d/]	6	55	3	0.50	97
	4/17[d/]	6	71	5	0.83	83
					$\bar{x}$ = 0.33	88
1988/89	12/16	6	14	0	0.00	---
	1/11	2	0	0	0.00	---
	1/25	5	5	0	0.00	---
	4/12	15	5	0	0.00	---
	4/18[d/]	15	28	0	0.00	---
	4/29[d/]	15	47	5	0.33	127
					$\bar{x}$ = 0.06	127
1989/90	12/13	9	66	2	0.22	222
	1/12	20	18	0	0.00	---
	2/14	19	22	2	0.11	152
	3/06	25	24	2	0.08	216
	3/21	26	30	0	0.00	---
	4/18	30	54	8	0.27	188
	5/01	30	9	1	0.03	154
					$\bar{x}$ = 0.10	186

[a/] Double-sample fixed wing and helicopter surveys only; estimates developed from first pass only.

[b/] Includes all marked animals known or assumed to be in population (survey area) at time of survey.

[c/] $N = [(M + 1)(C + 1)/(R + 1)] - 1$ (Rice and Harder 1977, after Chapman 1952).

[d/] Helicopter (classification) surveys.

Table 2. Aerial survey data, mark-recapture estimates of elk populations in the Spotted Bear winter range area, 1988-1990.

Year	Survey Date[a/]	Total Marked(M)[b/]	Total Seen(C)	Marked Animals Seen(R)	Observability (R/M)	Population Estimate(N)[c/]
1987/88	1/27	9	30	0	0.00	---
	2/26	8	119	3	0.38	269
	3/10	8	368	6	0.75	472
					$\bar{x}$ = 0.38	371
1988/89	1/19	9	72	0	0.00	---
	4/13	9	302	4	0.44	605
	4/19[d/]	14	371	7	0.50	697
					$\bar{x}$ = 0.31	651
1989/90	1/11	10	120	5	0.50	221
	3/07	15	330	6	0.40	756
	4/18[d/]	15	358	4	0.27	1,148
					x = 0.39	708

[a/] Double-sample fixed wing and helicopter surveys only; estimates developed from first pass only.

[b/] Includes all marked animals known or assumed to be in population (survey area) at time of survey.

[c/] N = [(M + 1)(C + 1)/(R + 1)] - 1 (Rice and Harder 1977, after Chapman 1952).

[d/] Helicopter (classification) surveys.

Sightability Model Indications, Variations in observability (sightability) are apparently greater in the denser habitats at Firefighter, where fixed-wing observability of marked animals averaged just 8 percent, than in the more open habitats at Spotted Bear (35 percent), particularly Dry Parks. Even within the Firefighter winter range, different canopy cover conditions led to highly variable fixed-wing sightability estimates (0-23%) for different winter range segments (Table 3). Sightability was highest, for example in the Tiger Cr. - Canyon Cr. segment, which has been heavily logged at lower elevations. As expected, observability of marked animals increased dramatically using a helicopter; averages were 42 percent for Firefighter and 50 percent for Spotted Bear.

Sightability of elk was strongly influenced by canopy coverage at Firefighter (Fig. 9). Sixty percent of elk groups containing marked animals were seen when in open areas (0-5% canopy cover), while sightability dropped to just 6% in areas with 50-75% canopy cover. When all five canopy coverage classes (0-5, 25-50, 50-75, 75-95, 95-100%) were considered, they showed a negative exponential relationship with sightability with an r-squared value of 87.02 percent.

Because most of Firefighter is forested; the relationship between group size and sightability was less clearly defined (0 values were derived for groups of 2, 3, and 5). Sightability averaged 13% for all groups, ranging from 0% for single elk to 100% for groups of >15, and varying from 33 to 67% for groups of 2-6 animals. Sightability for group sizes of 1, 4, 6 and >15 animals, however, showed a linear relationship with an r-squared value of 98.77 percent (Fig. 10).

Increased sample size during monitoring and evaluation should clarify these relationships, particularly if a better distribution of group size and canopy cover classes can be sampled (i.e. fewer data points of 0). We hope to continue to build a sightability model for Firefighter and Spotted Bear using fixed-wing aircraft. More frequent helicopter surveys will probably be necessary, however, if the use of marked animals is to be de-emphasized. Sightability analysis of Spotted Bear data was not completed for this report.

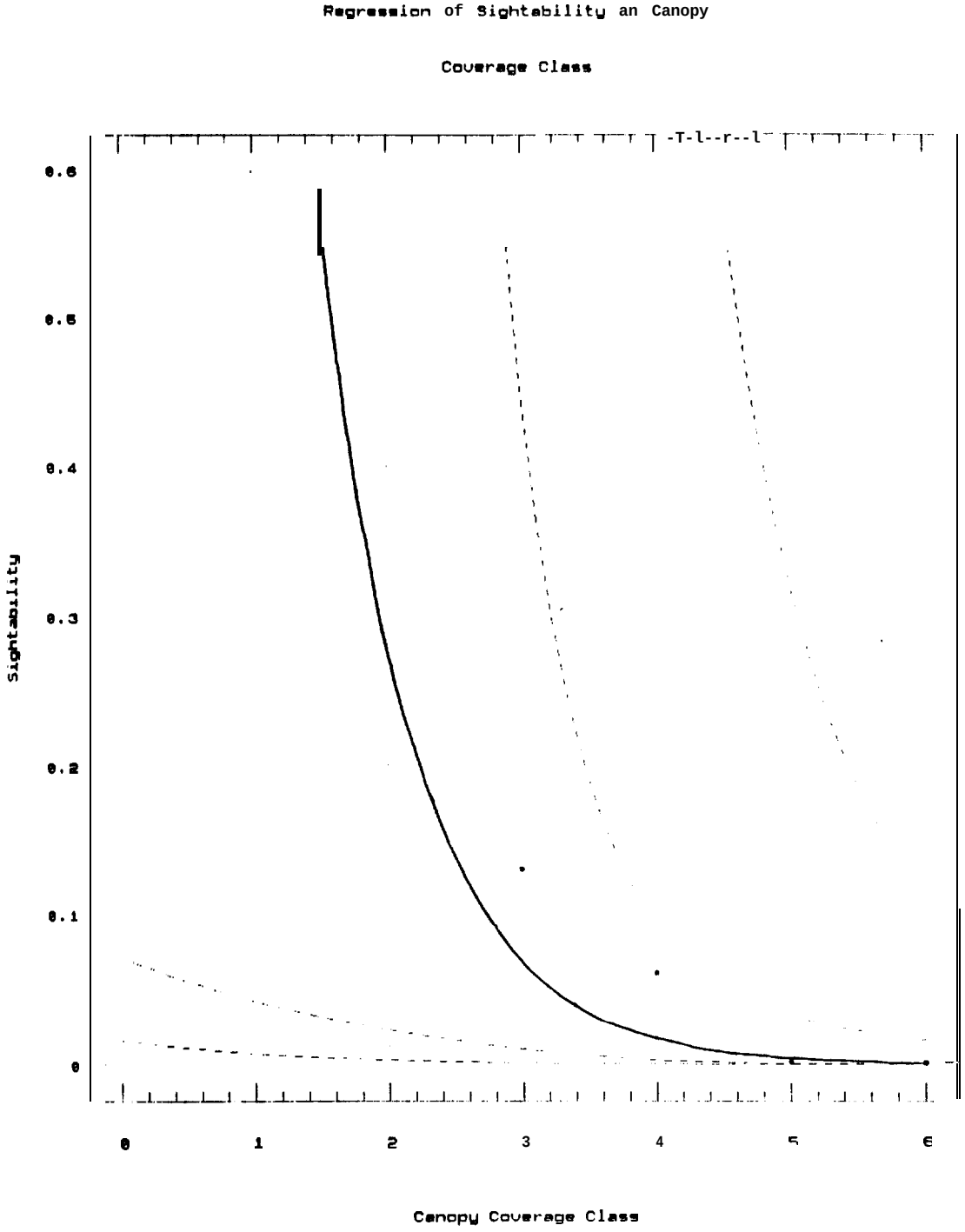
Pellet-Group Transects

Pellet-group survey data reflected habitat use and distribution patterns noted from the aerial survey data. Data from pellet-group transects at random sites and proposed treatment sites in 1988 indicated that elk winter use of the forested habitats at Firefighter was sporadic and well dispersed, with an average of just 1.0 elk-days/acre (Table 4). Data from 1989 yielded a similarly low value (0.7 elk-days/acre). Winter use of Treatment J, in a relatively diverse area in the core of the winter range, was nearly five-fold that of the highest use index for random sites (11.1 versus 2.5 elk-days/acre, Table 4) during the winter of 1987/88. Most marked elk spent nearly the entire winter of 1988/1989 on Hungry Horse Mountain, and this was also reflected in the pellet-group data. The population estimate derived from 1989 transects was lower, the overall index of elk use was lower (0.7 versus 1.0 elk-days/acre), and pellet-group densities

Table 3. Sightability of marked elk by group size and winter range segment, Firefighter Mountain winter range, winters 1987/88, 88/89, and 89/90.

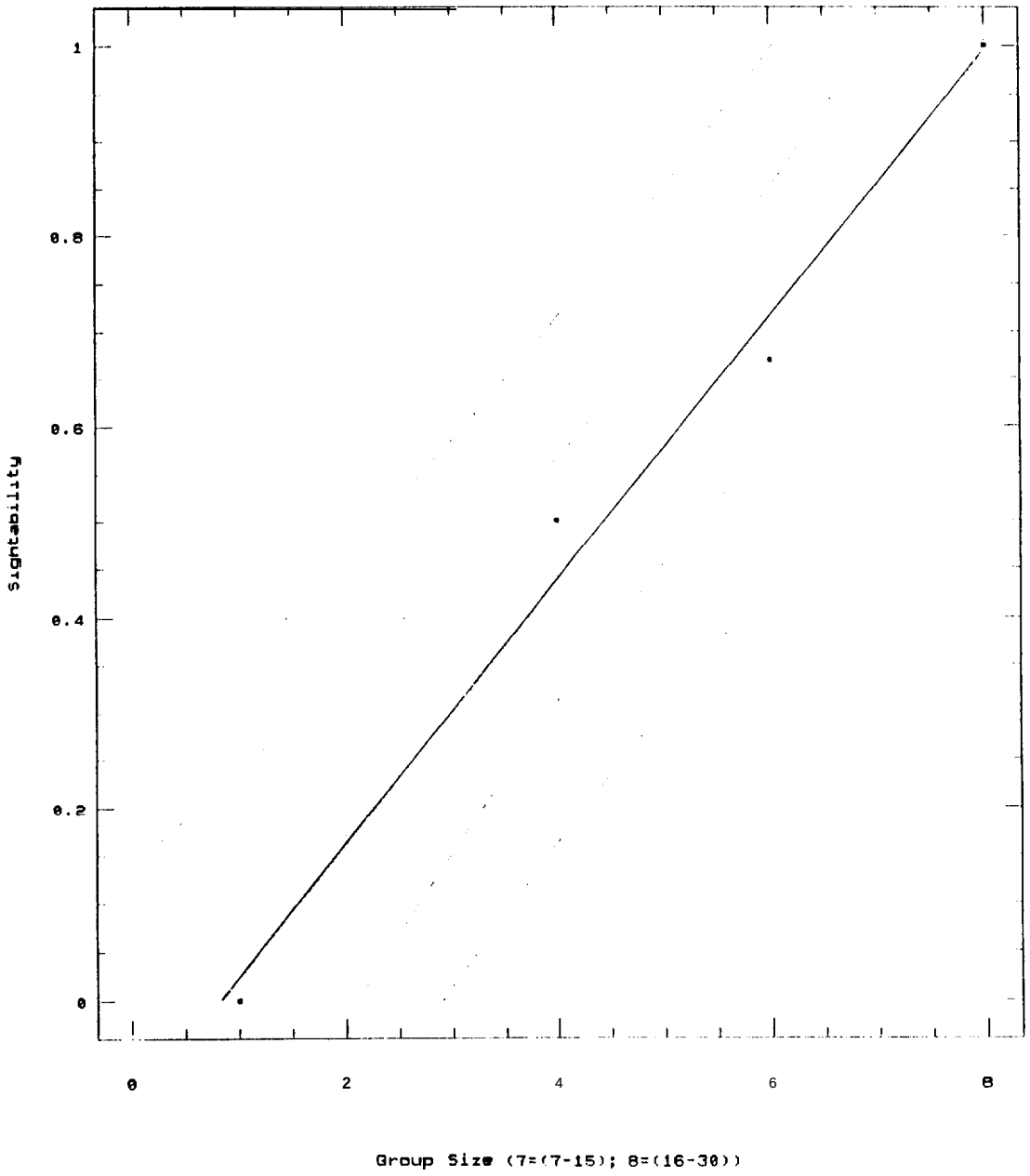
Group Size	Marked Groups Observed by Winter Range Segment'										
	Emery		H.H. Mountain		Tiger-Canyon		Firefighter		Entire		
	Seen	Not	Seen	Not	Seen	Not	Seen	Not	Seen	Not	Sightability by Group Size (Totals)
1	—	--	0	1	0	5	0	2	0	8	0.00
2	0	1	--	--	1	0	1	1	2	2	0.50
3	--	--	--	--	--	--	0	2	0	2	0.00
4	--	--	--	--	--	--	1	1	1	1	0.50
5	--	--	2	0	0	2	0	2	2	4	0.33
6	--	--	--	--	3	0	1	2	4	2	0.67
2 7	0	2	1	4	1	4	1	8	3	18	0.14
UNK	0	3	0	9	0	6	0	23	0	41	
Totals	0	6	3	14	5	17	4	41	12	78	
(Sightability)	(0.00)		(0.18)		(0.23)		(0.09)		(0.13)		

[a]Sightability calculated from groups including marked elk. Numbers represent groups seen or missed (not) during first pass of double-sample surveys.



Correlation Coefficient = -0.9328 R-squared = 87.02

Figure 9. Regression of elk sightability as a function of canopy closure class, Firefighter Mountain winter range.



Correlation Coefficient = 0.9938 R-squared = 98.77

Figure 10. Regression of elk sightability as a function of group size, Firefighter Mountain winter range.

Table 4. Pellet-group transect data, Firefighter Mountain winter range area, 1988 and 1989.

Year	Transect Type	N	$\bar{x}$ Number of Pellet-groups" (Range)	$\bar{x}$ Elk-days per acre (Range)
1988	Random	18	2 (0-8)	0.6 (0.0-2.5)
	Proposed Treatment Forested	2	0 (0)	0.0 (0.0)
	Natural Opening	1	36 (36)	11.1 (11.1)
	TOTALS	21	3 (0-36)	1.0 (0-36)
1988	Population Estimate[b/] = 174 elk			
1989	Random	15	2 (0-7)	0.7 (0.0-2.2)
	Proposed Treatment Forested	6	1 (0-2)	0.2 (0.0-0.6)
	Natural Opening	2	9 (8-9)	2.7 (2.5-2.8)
	TOTALS	23	2 (0-9)	0.7 (0.0-2.8)
1989	Population Estimate[b/] = 124			

[a/] Rounded to nearest whole number.

[b/] [Mean elk-days acre x (25,600 acres)] + (152 days), (153 days in 1988).

on natural openings within the Firefighter portion of the winter range (Treatments J, M) were much lower than the previous year, more closely approximating values for random (forested) points (Table 4).

Winter elk use indices for Spotted Bear averaged 2.9 elk-days/acre at random sites for 1987/88, and 6.9 elk-days/acre for 1988/89, when the 4 proposed treatment sites were included in the survey (Table 5). High pellet-group densities (up to 39.2 elk-days/acre) were recorded within proposed treatment areas in the Dry Parks area. These sites were selected for treatment based on high elk use and decadent shrub condition as noted during aerial and ground surveys.

Population estimates for Firefighter derived from pellet-group data roughly corresponded to the mark-recapture estimates for Firefighter (Casey and Malta 1990b). While Spotted Bear estimates from pellet-group densities were higher than the mark-recapture estimates, they included more geographic area (i.e. Hoke Cr., Spotted Bear Mountain), and are consistent with previous estimates of elk density in the Spotted Bear winter range (Biggins 1975, Cross, pers. comm.).

Mule Deer

Twelve female mule deer were marked at two trapsites at Spotted Bear during the report period, and all are assumed to still be in the population. All sightings of marked mule deer have been recorded, but to date no distribution maps or mark-recapture estimates have been developed. All marked mule deer are apparently part of a resident herd which inhabits Horse Ridge and Spotted Bear Mountain. Mule deer occur sporadically throughout the rest of both winter ranges, but none were captured elsewhere in either area.

Vegetation Baseline Data

Browse Transects. The Firefighter area is generally densely forested, and dominated by hiding and general thermal cover types (USDA Forest Service 1990). Preferred shrub forage species such as serviceberry and mountain maple are present throughout the area, but comprise a small component of the shrub layer (Fig. 11). Huckleberry species comprised over 35% of the shrubs encountered on browse transects during both 1988 and 1989. Serviceberry averaged 9.8% of the shrubs on these transects, and maple averaged just 2.8 percent (Fig. 11). Spotted Bear, on the other hand, is dominated by shrubland and supports a higher density of serviceberry (mean = 25%), as well as redstem ceanothus, which comprised over 10% of the shrubs on transects run in 1989 (Fig. 12). Scientific names and species codes used for all browse species encountered on browse transects are listed in Appendix J.

Baseline data supported the concept of creating S-facing openings to increase availability of preferred browse. Serviceberry was most abundant in areas with 0-25 % canopy cover, and the proportion of huckleberry in the shrub component at

Table 5. Pellet-group transect data, Spotted Bear winter range area, 1988 and 1989.

Year	Transect Type	N	$\bar{x}$ Number of Pellet-groups[a] (Range)	$\bar{x}$ Elk-days per acre (Range)
1988	Random	16	9 (0-52)	2.9 (0.0-16.1)
	TOTALS	16	9 (0-52)	2.9 (0.0-16.1)
1988	Population Estimate[b] = 842 elk			
1989	Random	16	11 (1-60)	3.5 (0.3-18.5)
	Proposed Treatment (Natural Openings)	4	67 (17-127)	20.6 (5.3-39.2)
	TOTALS	20	22 (1-127)	6.9 (0.3-39.2)
1989	Population Estimate[b] = 1,030[c]			

[a] Rounded to nearest whole number.

[b] [Mean elk-days acre x (25,600 acres)] ÷ (152 days), (153 days in 1988).

[c] Calculated from random sites only.

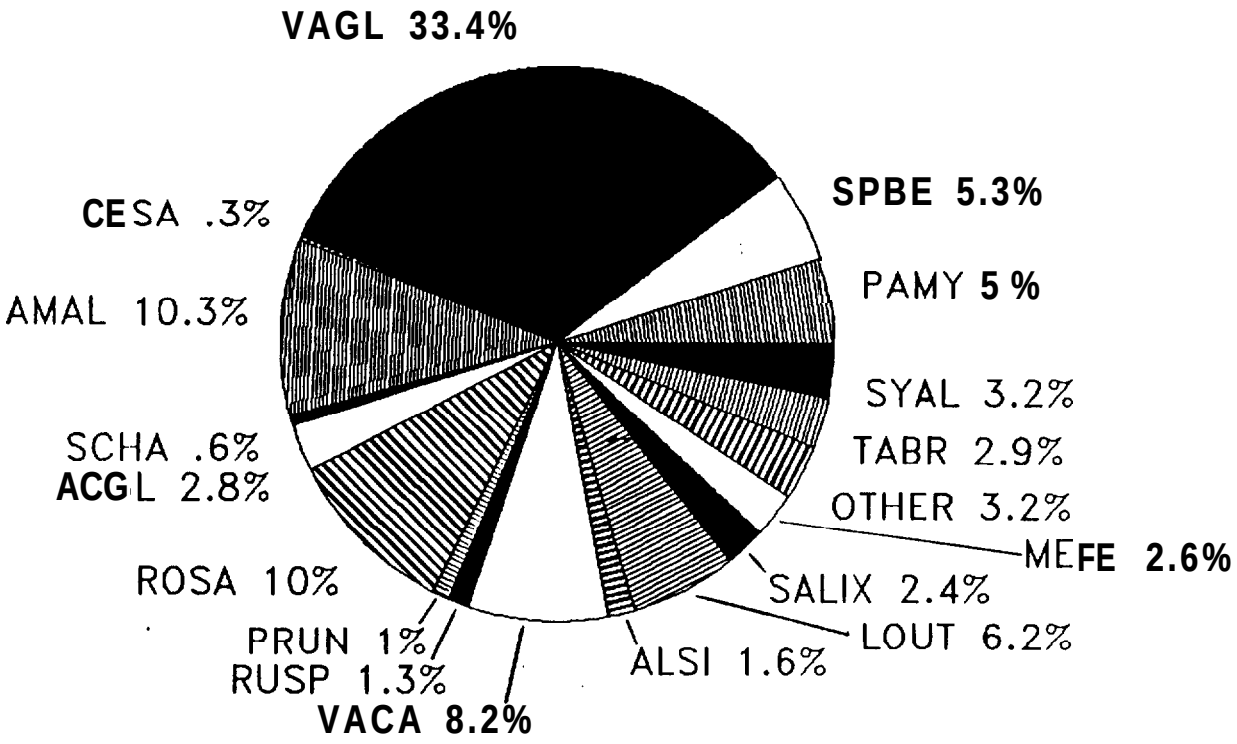


Figure 11. Relative abundance of shrub forage species, as determined from browse transect data, Firefighter Mountain winter range area.

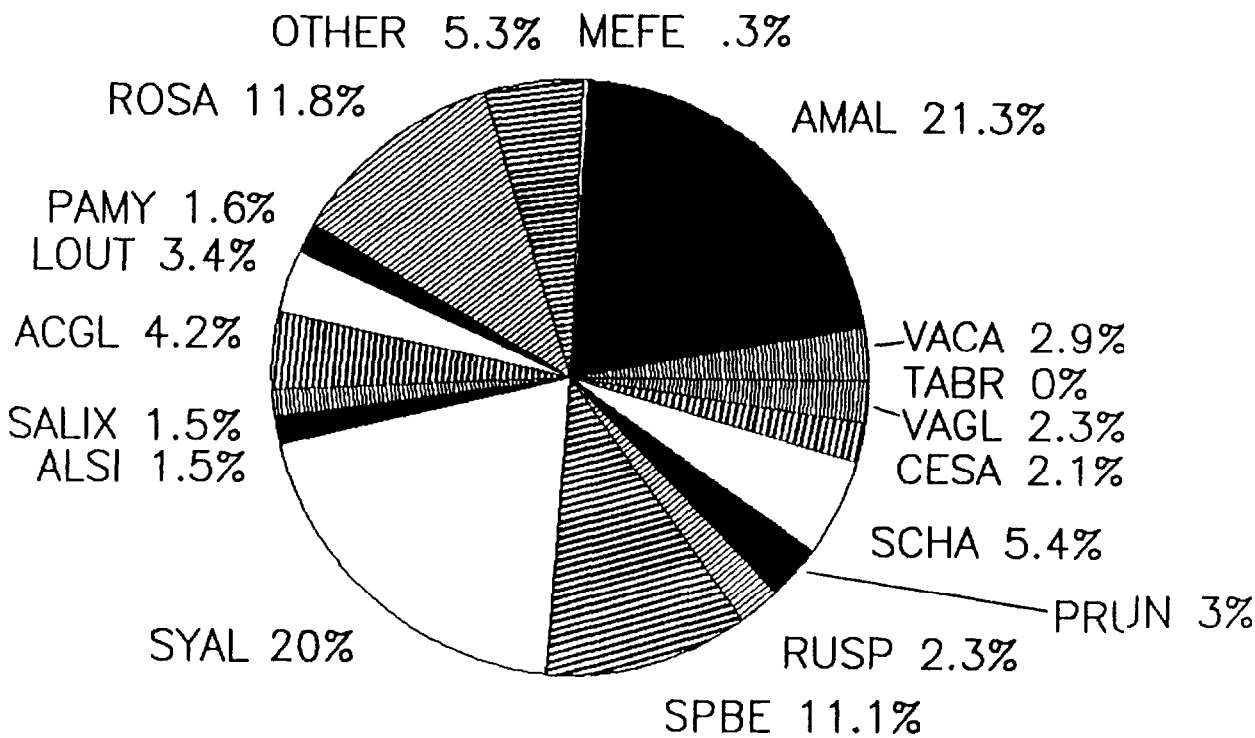


Figure 12. Relative abundance of shrub forage species, as determined from browse transect data, Spotted Bear winter range area.

Firefighter increased as canopy coverage increased. Serviceberry was also most common on transects with W, E, and S aspects (Fig. 13). As hiding cover on SE-to W-aspects is converted to forage openings, species composition (dominance) is likely to shift from huckleberry to serviceberry.

Canopy and aspect trends in shrub species composition were similar at Spotted Bear. Huckleberry and buffaloberry were most common at higher tree canopy coverage values, and were "replaced" by serviceberry and snowberry in areas with lower canopy coverage. Serviceberry was most abundant on S and E aspects, while redstem ceanothus was present only on S and W aspects (Casey and Malta 1990b).

Rose (26%), willow (27%), maple (23%) and serviceberry (15%) had the highest browse utilization indices based on twig counts (Stickney 1966), for Firefighter transects run in 1988 (Table 6). Redstem ceanothus was heavily used in the few areas where it occurred. Twig length indices (Aldous 1944) were harder to interpret, but still gave indications of elk preference, Maple had the highest positive index (1.00), indicating that on the average, all current annual growth was eaten on browsed twigs (Table 6). Serviceberry, on the other hand, had an index of just 0.02 (Table 6). Elk typically selected robust, lengthy leaders on serviceberry, leaving smaller shoots on decadent twigs intact. Hence even after browsing, remaining portions of browsed twigs were nearly as long as unbrowsed twigs. In an extreme case of this phenomenon, negative values were calculated for honeysuckle, redstem ceanothus and maple in 1989. For this reason, twig length indices of browse utilization will probably have little value as a long-term evaluation technique. Leader length of unbrowsed twigs will still be used as a technique for evaluating shrub response, however.

Serviceberry, rose and maple were the most heavily-utilized shrubs at Spotted Bear in 1988, as indicated by browsed twig count. Maple, ceanothus and honeysuckle were most heavily used in 1989 (Table 9). Trends in twig length indices closely paralleled those calculated for Firefighter (Casey and Malta 1990b).

Browse utilization transects were useful for identifying preferred browse species and their abundance relative to aspect and canopy coverage classes. Analysis of browse form class data (Cole 1959) and density relationships will be included in the final draft of this monitoring and evaluation plan. Food habits data (from pellets collected during transect work) will be summarized in subsequent annual reports.

ECODATA Plots. Summaries of the ECODATA plots sampled in proposed treatment sites are in project files. Results will be combined with additional plot data before further analysis.

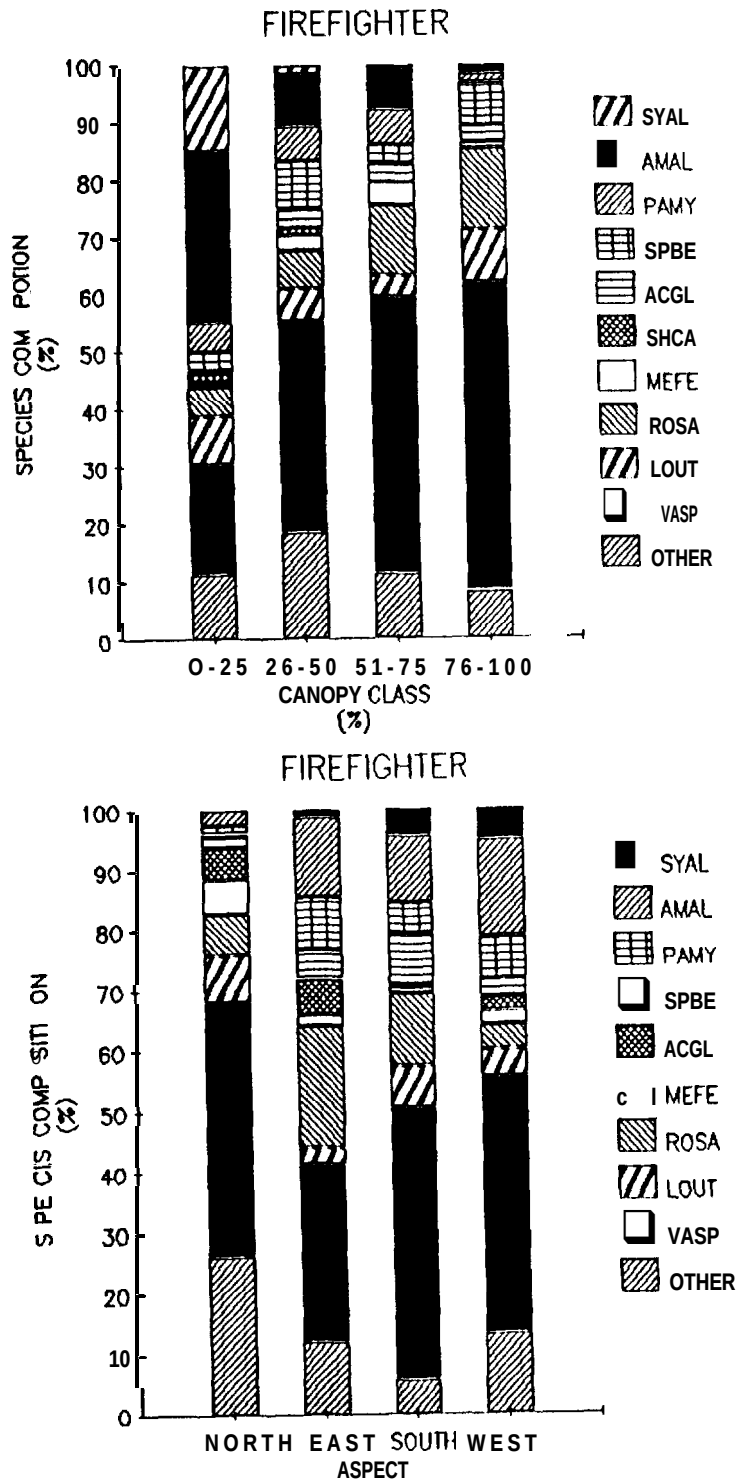


Figure 13. Relative abundance (%) of shrub species by canopy coverage class and aspect, Firefighter Mountain winter range.

Table 6. Browse utilization transect data, Firefighter Mountain winter range, 1988 and 1989.

		Browse Utilization Indices		$\bar{x}$ Twig length (mm)[d]	
	Relative Abundances[a]	Twig Count[b]	Twig Length[c]	Browsed	Unbrowsed
1988:					
Serviceberry (AMAL)	0.13	0.15	0.02	44.6	45.7
Maple (ACGL)	0.03	0.05	1.00	0.0	34.4
Rose (ROSA)	0.10	0.26	0.09	78.2	85.6
Cherry (PRUN)	0.01	0.07	0.12	25.0	28.5
Honeysuckle (LOUT)	0.07	0.06	-0.57	113.2	71.9
Huckleberry (VAGL)	0.28	0.09	0.29	25.9	36.6
Willow (SALIX)	0.04	0.27	0.80	38.4	191.3
1989:					
Serviceberry (AMAL)	0.07	0.07	0.23	13.1	17.1
Maple (ACGL)	0.03	0.23	-0.46	106.0	72.7
Ceanothus (CESA)	0.006	0.23	-0.45	235.5	162.5
Rose (ROSA)	0.11	0.10	0.53	21.7	46.6
Cherry (PRUN)	0.01	0.03	1.00	0.0	12.2
Honesuckle (LOUT)	0.05	0.01	1.00	0.0	61.3
Huckleberry (VAGL)	0.42	0.03	0.63	10.0	27.2
Willow (SALIX)	0.008	0.26	0.66	19.5	57.4

[a] No. of individual shrubs of species x/total number of shrubs (all transects).

[b] Mean (no. of browsed twigs/total no. twigs counted).

[c] Mean length of browsed twigs/mean length of unbrowsed twigs (negative values indicate that browsed twigs averaged longer than unbrowsed; value of 1.0 means entire twig was eaten).

[d] Length of current annual growth from previous year.

MONITORING AND EVALUATION PLAN

The final objective of the two-year advance design phase of this project was the development of a statistically-sound, site-specific (population and habitat) monitoring plan. This plan includes specific schedules, sample sizes, and methods based not only on current "state of the art", but on preliminary habitat and population studies within the project area. The monitoring effort will serve as our tool for evaluating whether mitigation is being achieved. The population monitoring portion of the plan is structured to determine current population size and distribution, herd structure, population dynamics, and the changes in these attributes as enhancement activities are implemented. The habitat monitoring effort will document changes in the density, species composition, canopy coverage, and vigor of forage plants and other key vegetation in treatment and control areas.

The data collected during the evaluation phase will serve to direct future management (enhancement) actions. This project allows for adaptive management, with an accounting against mitigation goals as a driving influence, i.e.:

A. Assess new population status against baseline, and against mitigation goals.

B. Evaluate whether habitat goals have been met.

C. Recommend management actions.
   1. Revised treatment schedules.
   2. Revised enhancement techniques.
   3. Revised acreage goals.
   4. Revised population goals.
   5. Revised monitoring methods

The mitigation plan developed for Hungry Horse assumed overlapping benefits from separate mitigation projects (Bissell and Yde 1985). How these overlapping species benefits will be accounted for has not been resolved. The Wildlife Mitigation Trust Advisory Committee's input will help determine the extent to which other species are monitored as the enhancement project is implemented.

Long-Term Enhancement Goals

The Hungry Horse elk project is based on the assumption that carrying capacity can be increased, by habitat enhancement which will contribute to increased productivity and/or decreased mortality. Since both productivity and natural mortality of elk are closely tied to their physiological condition (Taber et al. 1982), providing more, higher quality forage should lead to population increases. Burning has been shown to be an effective tool for improving forage quality. Dead stems are removed, encroachment by trees is forestalled, and nutrients are recycled, allowing robust new growth. Most preferred browse species have been shown to increase in density, production, and vigor within the

first few years after burning (Noste and Bushey 1987). Over the long term, habitat treatment areas will be designed and maintained provide the combination of forage and cover verified to be most effective on a site specific basis. Re-treatment (e.g. burning at designated intervals) may be necessary to maintain forage quality.

Vegetation data collected to date supports our assumption that the forage base at Firefighter limits the distribution and size of the winter elk population. Cover/forage ratios are highly skewed toward cover (87:13), and preferred browse species are generally in poor condition as indicated by twig length (Table 8). Winter elk distribution at Firefighter is centered on the northwest portion of the area, which has more natural openings and better interspersion of cover types than the southern portion of the area.

As the primary target species of the project, elk will receive the greatest benefit from the habitat enhancement activities. Within one to three years following initial treatment, the quantity and quality of forage available to elk should have increased. It is likely, however, that population responses will not express themselves until several years of enhancement activities have taken place, along with the physiological changes leading to increased natality and/or decreased mortality, Ideally, the long term changes from this project and additional enhancement in the region will result in a habitat mosaic capable of carrying the extra 133 elk identified as a mitigation goal.

Population Monitoring (Population Response)

The goals of the population monitoring effort are to calculate annual bounded population estimates for the project areas, and to document changes in distribution and elk use of specific winter range segments and treatment areas. Population (sex and age) structure and elk harvest will also serve as important ways to evaluate population response to habitat treatments.

The key variables in calculating population estimates (Rice and Harder 1977, Samuel et al. 1987) are the percent of the population marked (in the survey area at the time of the survey), and sightability (by winter range, winter range segment, group size, and/or canopy cover). These can be used to extrapolate from actual count data to a population estimate with a known confidence interval. Our baseline data provided the opportunity to calculate sample sizes needed to provide the desired level of precision in our population estimates.

Trapping. Additional trapping and marking will be necessary during winter 1990/91, to bring our marked sample up to at least 25 % of the population at Firefighter, or about 45 animals. Our preliminary goal is to mark 15-20 additional animals in each winter range. We will continue to utilize trapsites which have provided consistent capture rates (Appendix K), such as the two sites at Hungry Horse Mountain (approximately 3 t-n/elk), Road 896 (approx. 4 t-n/elk), and the Elk Island Overlook/Deep Creek area (approx 6 t-n/elk). Because of the success of the corral trap at the Spotted Bear Pole Barn, we built a similar trap

for use at Road 896, which might help us to achieve our goals more rapidly. We will still use Clover traps at other sites. Large marked samples from single trapsites (i.e. corral traps) are likely to provide a wide distribution of marked animals for surveys, as indicated by analysis of our first three years' radiolocation data (Appendix H).

The need for additional trapping and marking will be re-assessed on an annual basis. We will need to maintain a marked sample of 40-50 elk at Firefighter through the winter of 1994/95 in order to adequately assess response to enhancement and build a usable model. If a strong enough sightability model can be built, we may not need to mark additional animals beyond that date. We will maintain the marked sample at Spotted Bear at least until the potential for additional enhancement work in that area has been assessed.

Population Surveys. Double-sampling during aerial surveys will continue, to further refine sightability estimates for various herd units within each winter range. Airplanes will continue to be the primary method for aerial surveys, but helicopter surveys will be conducted as needed to provide adequate sample size (i.e. 60 animals seen per survey at Firefighter). Our goals for the winter of 1990/91 (15 Dec.- 15 May), are to conduct at least 10 fixed-wing and 4 helicopter surveys to calculate mark-recapture estimates at Firefighter, and at least 6 fixed-wing and 2 helicopter surveys at Spotted Bear. By the end of winter,, we should have >30 active radiocollars at Firefighter. This should increase the number of surveys suitable for calculation of population estimates (i.e. at least one collar seen during the first pass).

We will continue to gather sex and age distribution (population structure) data from animals trapped, classified during aerial surveys, and killed by hunters. Through surveys at hunter check stations, analysis of harvest data, and natural mortalities of marked animals, we will monitor the rate of turnover in the population. Such data may also indicate whether enhancement activities affect the distribution or success of hunters, and how such an effect influences progress toward mitigation goals. More detailed information on recent mortality rates on both winter ranges will be included in the final version of this plan.

Pellet-Group Transects. We will continue to monitor permanent pellet-group transects (Casey and Malta 1990b) on an annual basis. Pellet-group transects will also be sampled at each of the ECODATA plot locations, which will also be permanently marked. These data will serve as an index of elk use in selected treatment sites, and at random control points sampled during the baseline phase of the project. Approximately 40-50 transects will be sampled each year during the first five years of implementation (1990-1995). Sampling intensity will then most likely decrease, with key sites being sampled periodically (perhaps every two years).

Ten individual pellet-groups will be collected monthly during winter (Jan. - May) to analyze elk food habits in the project area. They will be sent to Colorado State University for identification of plant food items to at least the

genus level. Percent occurrence in these samples will serve as an index of food preference, and will help to verify if enhancement activities are targeting the correct forage species, show seasonal shifts in diet, and to help identify those species which will receive an emphasis during vegetation surveys. These data will be collected for at least the first three years of project implementation. Periodic food habits sampling may occur during later years of monitoring.

Vegetation Monitoring (Habitat Response)

Site-specific treatment response will be described in several ways. The initial effectiveness of treatment (e.g. extent of burn) will be recorded photographically and in narrative. Browse transects will be conducted to monitor utilization and vigor of preferred shrub forage species. Vegetation plots (ECODATA, USDA Forest Service handbook) will be sampled in selected treatment stands prior to treatment , and again on an annual basis for at least two years thereafter. Game-proof exclosures (Casey et al. 1988) will also be used to monitor forage response to treatment. Permanent photo plots will be established at representative sites, and will include the exclosures where applicable. , Browse transect and ECODATA stakes serve as the permanent photo points in treatment areas. Vegetation responses will be compared between those sites seeded and fertilized (Casey et al. 1988) and control sites, and between treatment types. Stands treated prior to the initiation of the project (i.e. wildlife burns, clearcuts, thinned stands) will also be analyzed. This should shorten the time necessary to assess long-term enhancement effects.

Cover/forage ratios based on digitized elk habitat maps will be re-calculated during the fifth year following initial enhancement activities, to assess progress toward the desired future condition (USDA Forest Service 1990). Elk habitat effectiveness (Lyon 1979) will also be re-calculated for comparison with baseline conditions, to assess whether summer habitat quality is compromised by the management activities undertaken during enhancement efforts.

Browse Transects. Browse transects will be monitored in conjunction with ECODATA plots, to provide information on browse preference and utilization, species composition, and condition, according to the methods used during the baseline data collection (Casey and Malta 1990b). The length of unbrowsed twigs will be measured to assess vigor of forage species. A subset of the baseline random (control) transect locations and the ECODATA plot locations (20-30 sites) will be sampled each year during the period 1990-1995. At that time, a reduced sampling effort will be designed to monitor trends and fill any data gaps.

ECODATA Plots. A greatly expanded ECODATA sampling effort will be necessary to provide detailed descriptions of the vegetative communities of treatment sites and control areas as enhancement activities begin. This set of standardized methods will provide data compatible with other USFS projects, and the data sheets, methods, and analysis software are all in place at the District level.

We selected the Short Nested Microplot method from the ECODATA Handbook, to monitor vegetation changes over time. This method is designed to assess such changes statistically, through the measurement of the nested rooted frequency of selected plant species. This method is particularly well suited to monitoring changes over time as a function of management activities, for a selected group of species, and results in estimates of ground cover, biomass by life form (production, optional), species composition, nested rooted frequency, foliage canopy coverage, and density (optional) for those species selected. We will use the optional methods for both density and production, since these variables will serve as important measures of enhancement success. At each site, we will record data for preferred and dominant forage species, including shrubs, grasses and forbs. At a minimum, these will include serviceberry, mountain maple, huckleberry, redstem ceanothus, beargrass, and all graminoids.

All microplot sampling points will be permanently marked; baseline points will serve as photo points. Five, 20x20 in. microplots will be sampled at set points along each of five, 66-ft parallel transects, randomly spaced along and perpendicular to the baseline (ECODATA Handbook). Additional microplots (10 per transect), and/or transects (7 per site) will be sampled, if necessary, based on the percent increase in new species recorded on successive plots (transects). Essentially, this means that sampling will be more intensive on sites with less uniform vegetation. Specific data collection and recording methods are described in the ECODATA handbook.

The number of sites we will sample per season was determined by our objectives, and the time it takes to sample a given site. Once established, it takes 4-6 hours to sample one site. With travel time and other sampling tasks (i.e. pellet-group sampling), we assumed one site could be sampled per field day. Given a field season for vegetation work of 15 June - 15 August, and other project tasks, we assumed that approximately 30 sites could be sampled each year. Selected sites will be sampled during each of the five growing seasons beginning in 1991. At least 3 sites representative of each primary type of enhancement activity or habitat were selected (Table 7). These include sites in natural openings selected for burning, dense seral lodgepole and larch stands, and mature mixed forest stands selected to include a variety of site characteristics (elevation, slope, aspect), as well as control sites for each primary habitat type. For the 5-year period covered by this plan, treatment sites to be treated during 1991-1993 were emphasized.

Table 7. Propoeed ECODATA plot locations by treatment (habitat enhancement) type and characteristics, Firefighter Mountain winter range, 1991-1995.

Habitat Type	Enhancement Activities[b]	# of Sites to be Treated 1991-1993	1994-1996	Tentative ECODATA Plot Locations[a] (n=29)
Natural Opening	Prescribed Burn	9	0	G, L, 62
	Control (none)	--	--	SE1/4 Sec. 27
Thinned Larch	Slash Shrube	4	2	31, 33, 35
	Control (none)	--	--	SW1/4 Sec. 33
Seral Forest[c]	Slash-BBF-Natural	3	3	F, 29
	Slash-BBS-Natural	0	1	--
	Slash-BBS-Plant	1	1	57
	Clearcut-BBF-Natural	5	2	04, 49
	Clearcut-BBS-Plant	9	1	A, 54, 58
	Control (none)	--	--	SW1/4 Sec. 33, SW1/4 Sec. 3, SE1/4 Sec. 11
Mature Mixed Forest	Clearcut-BBF-Natural	3	1	36, 39
	Clearcut-BBS-Plant	11	4	E, 28, 69
	Seedtree-BBF-Plant	1	0	C
	Seedtree-UBF-Plant	0	1	--
	Seedtree-UBF-Natural	0	2	--
	Seedtree-DP-Plant	1	0	B
	Shelterwood-UBF-Plant	0	1	--
	Control (none)	--	--	S1/2 Sec. 29, E1/2 Sec. 34

[a] Numbers and letters correspond to treatment sites, from Casey and Malta 1990.

[b] BBF = Broadcast burn, fall; BBS = Broadcaet burn, spring; UBF = Underburn, fall; DP = Dozer-pile slash; Natural = Natural regeneration; Plant = Plant seedlings.

[c] Dense, "doghair" larch (few) or lodgepole plne (most).

SUMMARY

During September 1987, BPA funded several wildlife enhancement projects in northwest Montana, including elk/mule deer winter range enhancement adjacent to Hungry Horse Reservoir. The initial phase of this enhancement project was designated as an advance design phase, to include initial (baseline) implementation of population and vegetation monitoring, habitat mapping, and detailed literature review. The contract also called for the preparation of a long-term implementation plan by December 1989, and a short-term plan to govern enhancement activities during the period 1988-1990.

The short-term plan was completed March 1988, by an interdisciplinary team of FWP and USFS specialists. Habitat treatment sites were selected in both the Firefighter and Dry Parks winter ranges, and treatments were scheduled to begin during the spring of 1989. More than 400 hundred acres were selected for treatment either through prescribed fire alone, or prescribed fire following slashing and/or timber harvest. These enhancement activities were eventually incorporated into the long-term enhancement plan, submitted to BPA during June 1990. Use of GIS databases allowed for the mapping of important elk cover types, old growth and other forest characteristics in the design and selection of long-term treatment sites. Enhancement activities will be funded through a trust fund agreement between FWP and BPA, with use of funds overseen by an Advisory Committee made up of representatives of the involved agencies and other regional interests.

Initial analysis of baseline data indicates that the Firefighter winter range is inhabited by approximately 180 elk, most of which are resident animals. Initial sightability models were developed for Firefighter, and indicated that sightability of marked animals was strongly correlated with both group size and canopy cover, but that more data are needed to develop a reliable model for future survey work. Two primary herd units were identified through analysis of radio-locations and group mapping. Firefighter and Hungry Horse Mountains comprise the core area inhabited by one herd unit, with the other centering on the Deep Creek area to the south. Both pellet-group and browse utilization transect data indicated low levels of elk use at random sites on Firefighter Mountain. Proposed treatment sites in natural shrubfields received more use. Forage condition was poor throughout the winter range, and preferred browse species such as serviceberry, maple and redstem ceanothus comprise less than 15 percent of the available shrub forage. Radio-marked elk occurred only sporadically in the extensively forested "greenslope" of seral lodgepole at the south end of Firefighter Mountain.

Initial population estimates for Spotted Bear indicate a wintering population of approximately 600 elk north of the Spotted Bear River. Preferred browse species are more abundant than at Firefighter. Elk-use indices for random sites averagedwellabove those for Firefighter; proposed treatment sites received the greatest use based on pellet-group densities. Data collection and analysis for

the Spotted Bear winter range was de-emphasized as Firefighter became the focus of enhancement efforts.

Analysis of data collected during the advance design phase of the project indicated that a larger sample of marked animals would be needed to adequately estimate population levels (and hence measure progress against mitigation goals) in the two winter ranges. A revised goal of >45 marked animals (>25% of the population) was calculated for Firefighter Mountain.

A population and vegetation monitoring plan was developed based on the methods and results of the advance design phase of the project (Casey and Malta 1990b). Monitoring and evaluation activities for the period 1991-1995 were described. Population monitoring will include additional trapping and marking, with double-sample aerial surveys being used to develop mark-recapture estimates and sightability curves. A minimum of 10 surveys of 60 animals, with at least one marked animal seen during the first pass in each survey, was set as the annual sampling goal. Approximately 40-50 pellet-group surveys will be conducted annually to monitor elk distribution and habitat use relative to enhancement sites. These will be located at permanently-marked sites, including random control sites sampled during baseline efforts, and at selected treatment sites. Pellets will also be collected during winter months to determine seasonal food preferences.

Approximately 30 treatment and control sites will be sampled for vegetation response on an annual basis using the USFS ECODATA Short Nested Microplotmethod. Additional browse transects will be conducted to monitor utilization and vigor of preferred browse species. In these ways, changes in abundance, density, dominance, frequency and current annual production of important forage and other shrub, forb and grass species will be monitored from pre-treatment conditions through the third growing season following initial treatment. Cover/forage and elk habitat effectiveness ratings will also be calculated at the end of the initial 5-yr evaluation period.

All proposed monitoring methods were designed to collect detailed, specific data relative to the success of enhancement efforts, at selected treatment sites deemed representative of the spectrum of sites selected for treatment. In all cases, the proposed intensity of sampling effort should decrease dramatically following the five-year period covered by this plan. It is our hope that this effort will result in an efficient, cost-effective set of techniques which can then be used on a periodic basis to track progress relative to mitigation goals,

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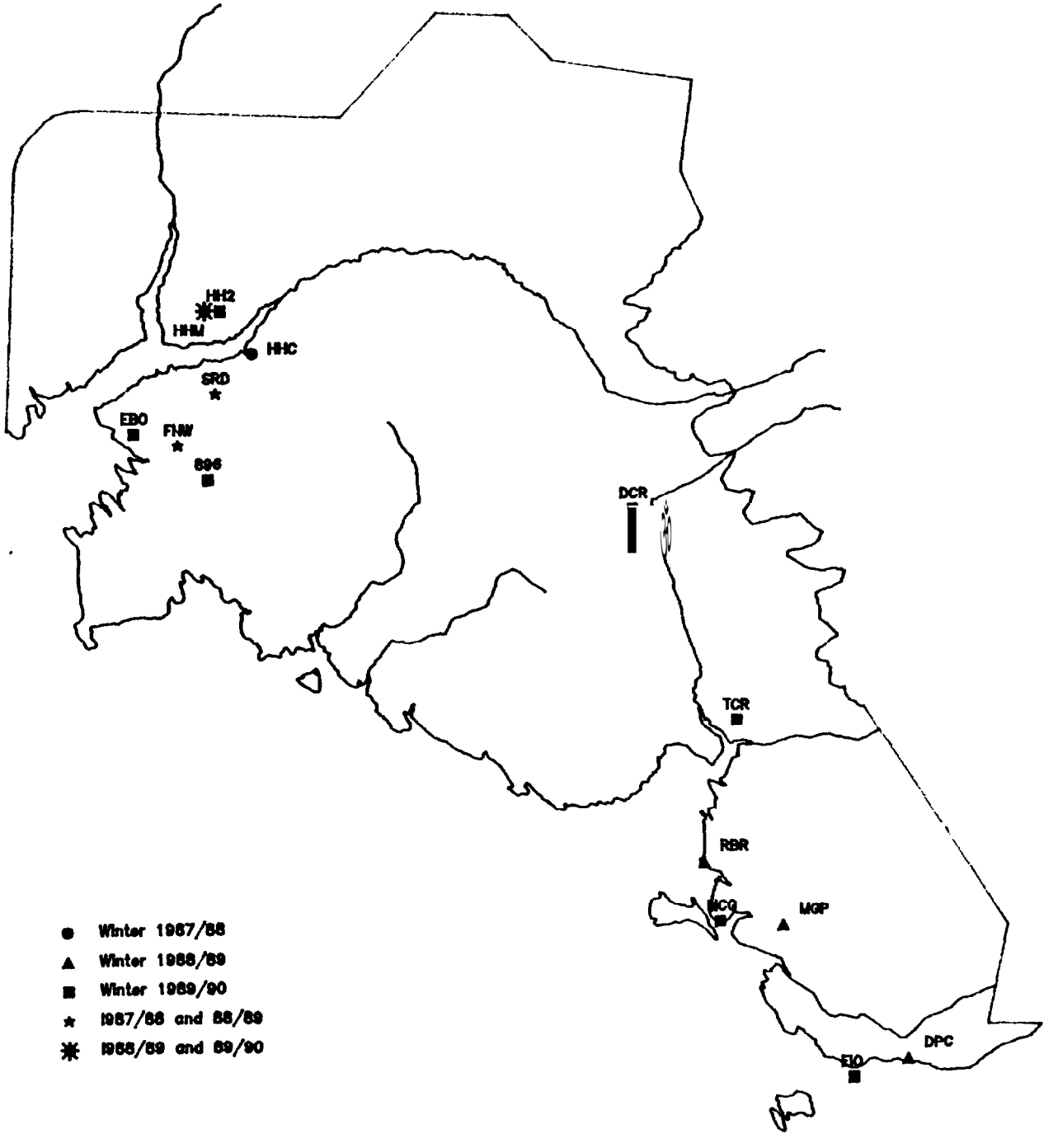
APPENDIX A

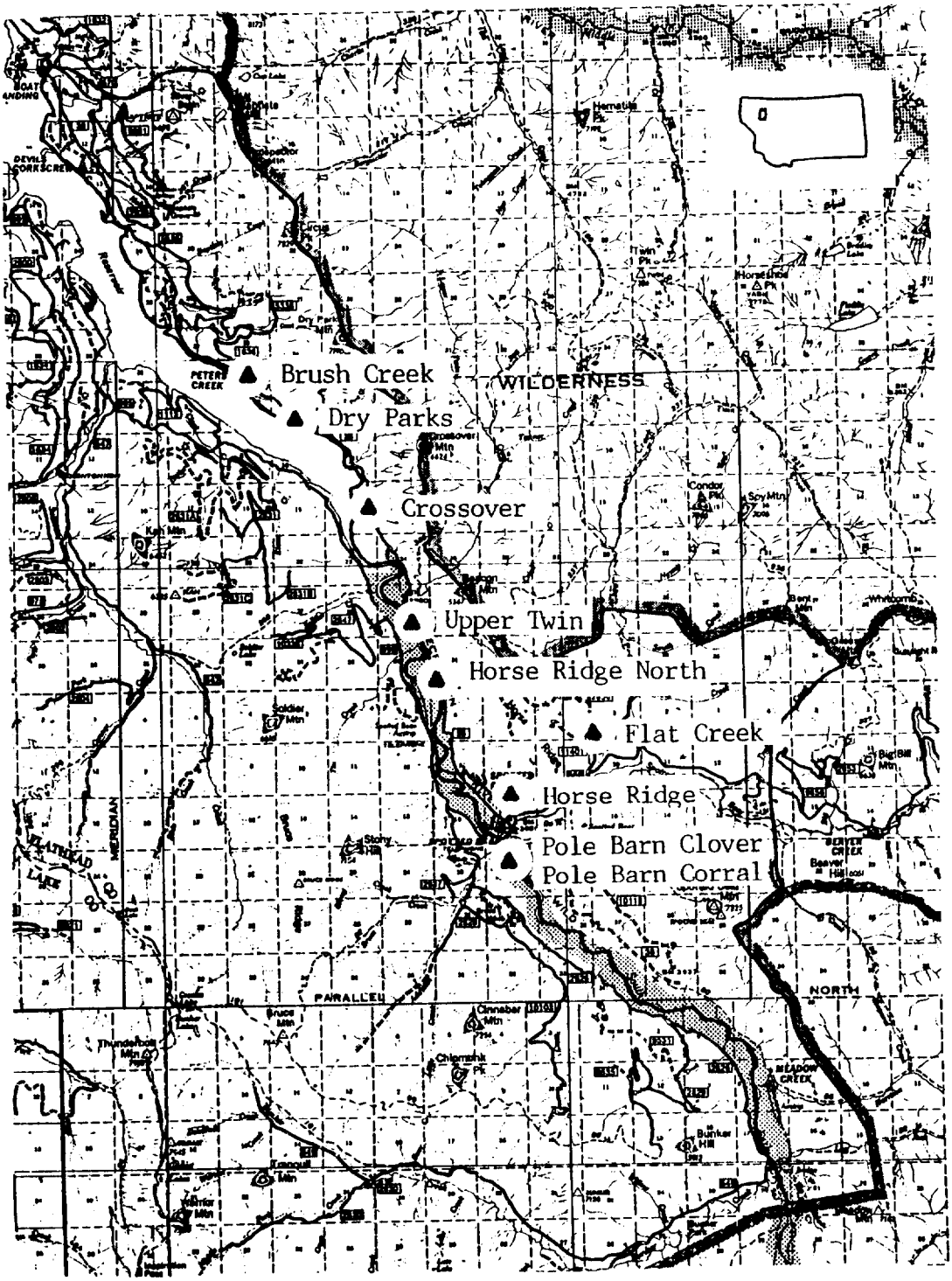
Elk trapsites, Firefighter Mountain winter range area.



HHM:Hungry Horse Mountain; HH2:Hungry Horse II; HHC:Hungry Horse Cut; SRD:Spur Road; EBO:Emery Bay Overlook; FNW:FirefighterNW; 896:Road 896; DCR:Dudley Creek; TCR:TentCreek; RBR:Riverside Boat Ramp; MCG:Murray Campground; MGP:Murray Gravel Pit; DPC:Deep Creek; EIO: Elk Island Overlook

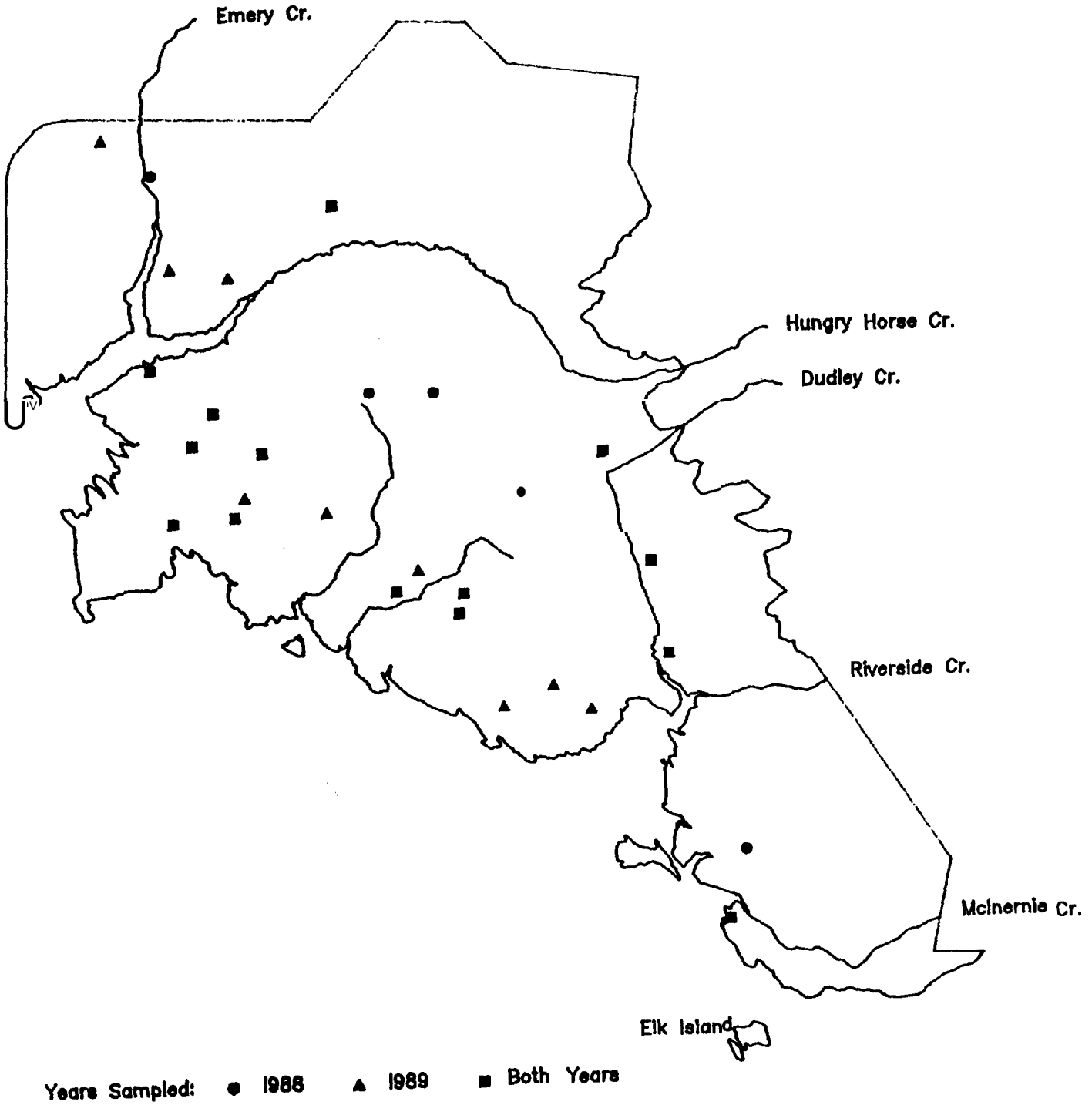
APPENDIX B

Elk trapsites, Spotted Bear winter range area.



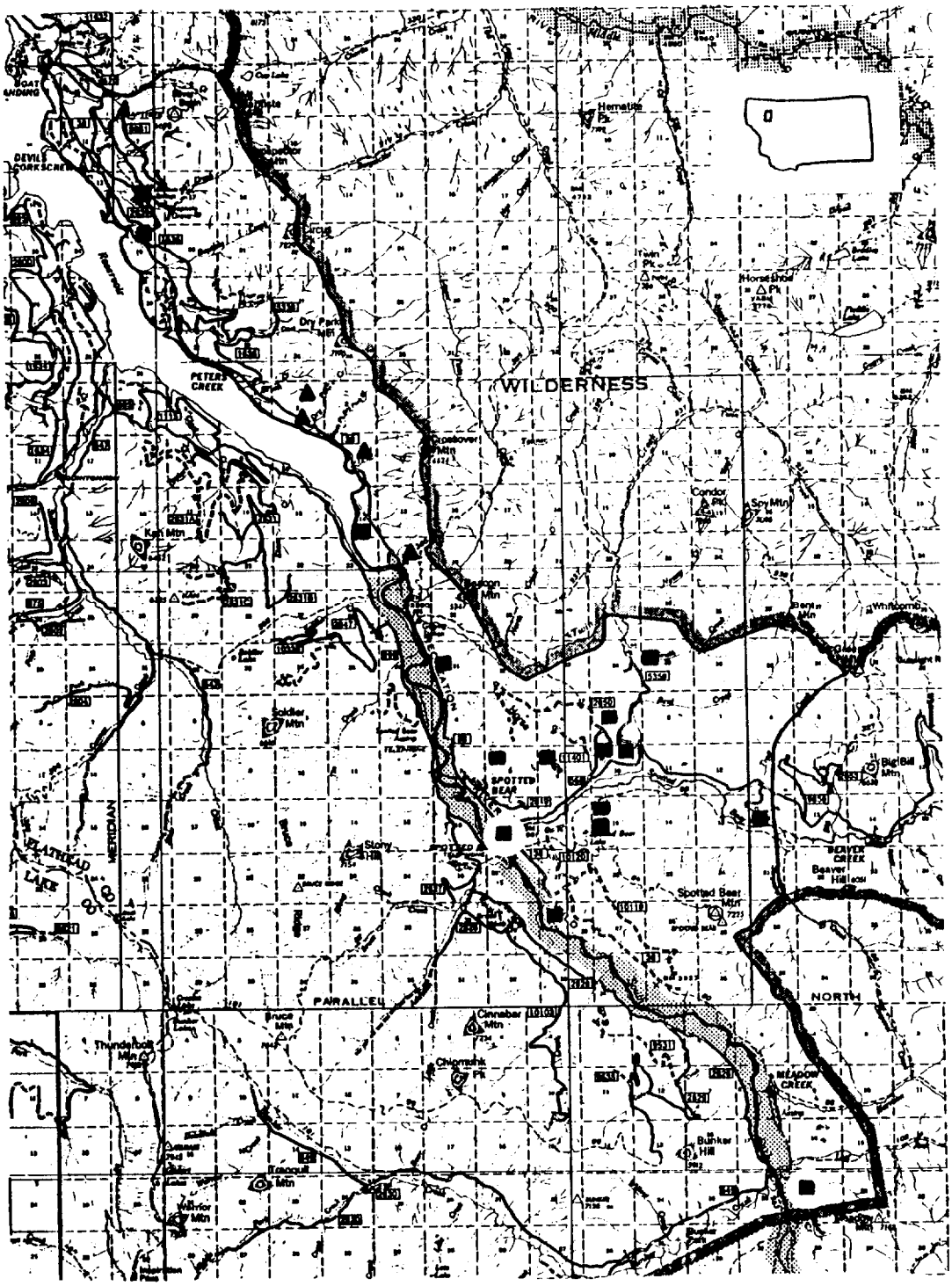
APPENDIX C

Locations of pellet-group transects sampled during 1988 and 1989, Firefighter Mountain winter range.



APPENDIX D

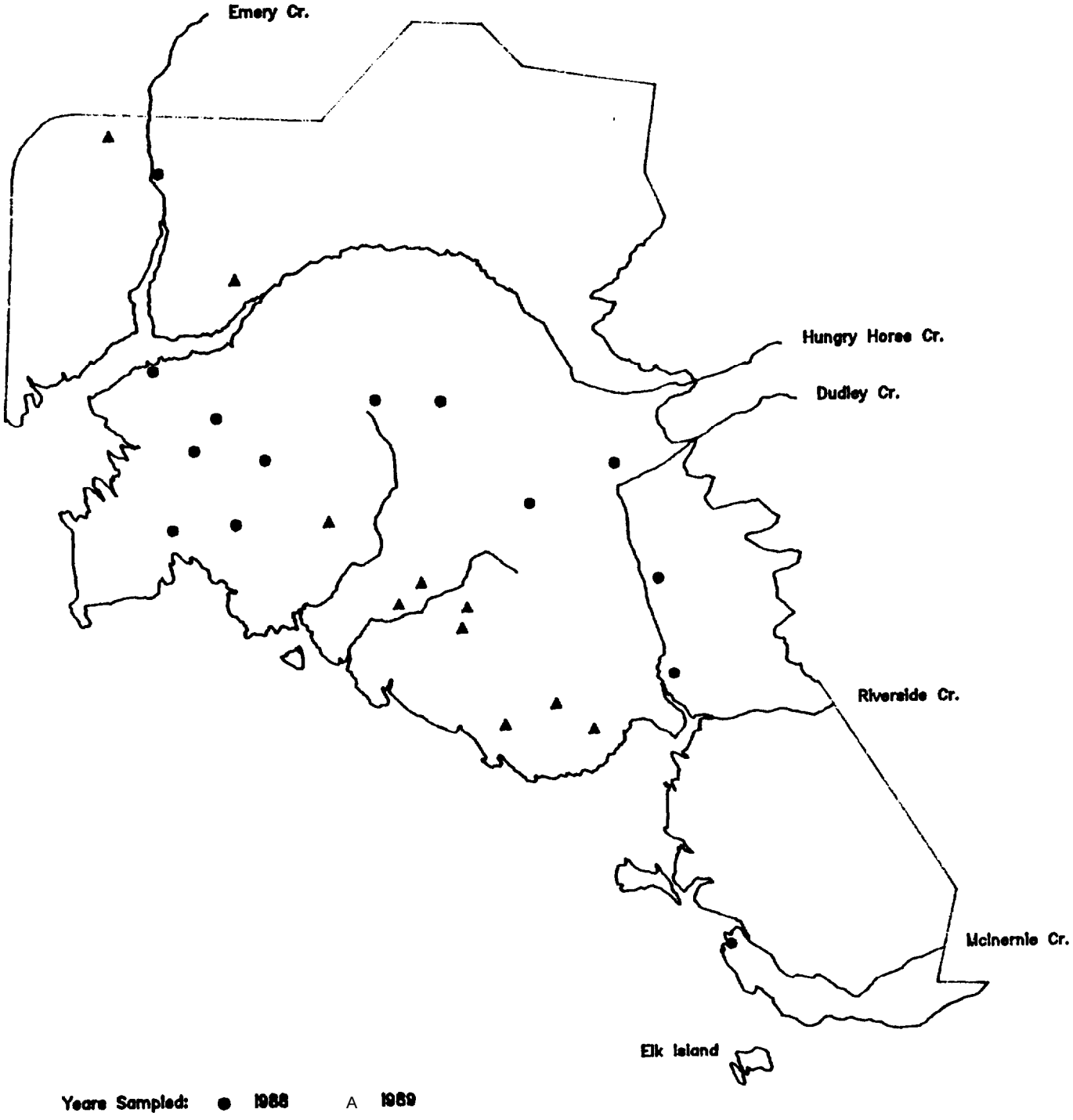
Locations of pellet-group transects sampled during 1988 and 1989, Spotted Bear winter range.



Year(s) sampled: ■ = 1988 and 1989; ▲ = 1989 only

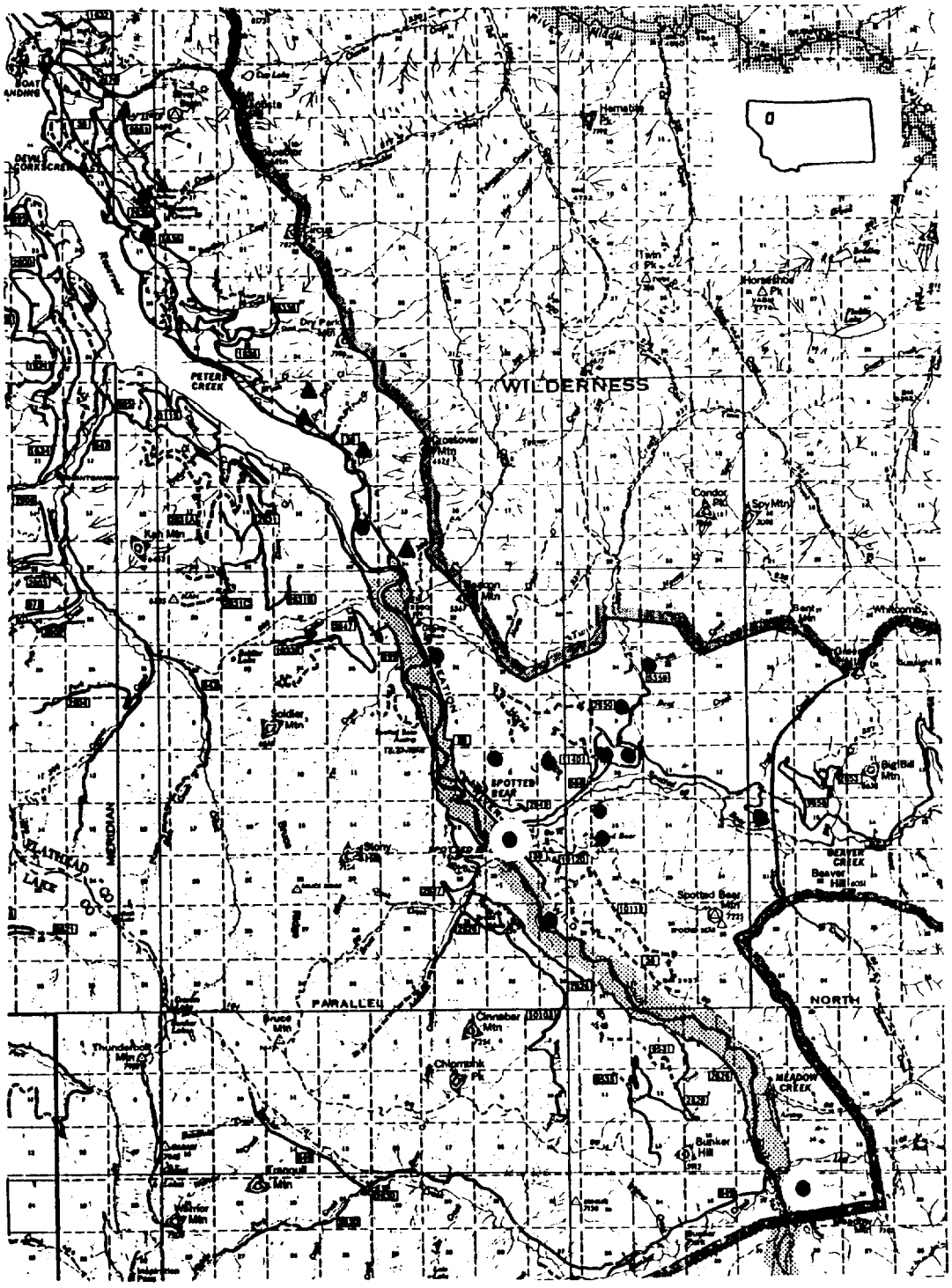
APPENDIX E

Locations of browse utilization transects, 1988 and 1989, Firefighter Mountain winter range.



APPENDIX F

Locations of browse utilization transects, 1988 and 1989, Spotted Bear winter range.



Year(s) sampled: o-1988; ▲ -1989

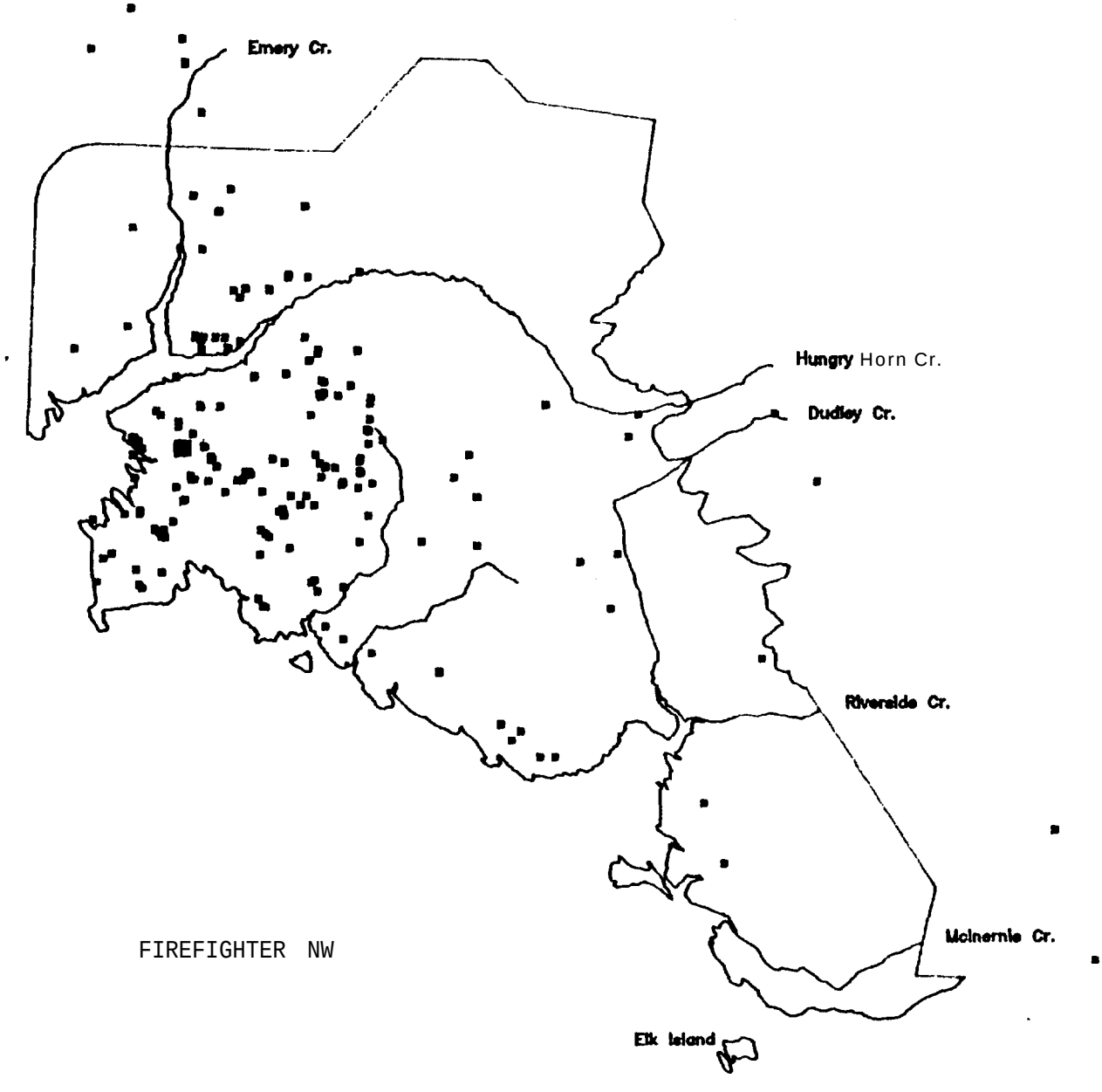
APPENDIX G

Trapping efficiency for traps within the Firefighter Mountain winter range area, NW Montana, 1988, 1989, 1990.

TRAPSITE	TRAP NITES	TOTAL CAPTS ELK	TOTAL CAPTS DEER	TOTAL MARKD ELK	TOTAL MARKD DEER	TOTAL ESCAP ELK	TOTAL ESCAP DEER	TOTAL RECAP ELK	TOTAL RECAP DEER	TOTAL MORT ELK	TOTAL MORT DEER
FIREFTR NW(88)	19	5	0	5	0	0	0	0	0	0	0
FIREFTR NW(89)	17	0	0	0	0	0	0	0	0	0	0
SPUR ROAD(88)	14	1	0	1	0	0	0	0	0	0	0
SPUR ROAD(89)	18	2	0	1	0	1	0	0	0	0	0
HH CUT(88)	17	1	0	0	0	1	0	0	0	0	0
RIVERSIDE(89)	19	0	0	0	0	0	0	0	0	0	0
MURRAY(89)	18	1	0	0	0	0	0	0	0	1	0
DEEP CR(89)	18	3	0	2	0	0	0	1	0	0	0
HH MOUNTN(89)	17	8	0	6	0	0	0	1	0	1	0
HH MOUNTN(90)	23	6	0	4	0	2	0	0	0	0	0
HH MTN II(90)	20	7	0	5	0	0	0	2	0	0	0
ROAD 896(90)	21	5	0	3	0	0	0	1	0	1	0
EMERY OVLK(90)	18	2	0	1	0	0	0	1	0	0	0
DUDLEY CR(90)	17	0	0	0	0	0	0	0	0	0	0
TENT CR(90)	17	0	0	0	0	0	0	0	0	0	0
MURRY CPGD(90)	14	1	0	1	0	0	0	0	0	0	0
ELK IS.OVK(90)	14	3	0	3	0	0	0	0	0	0	0
TOTALS	301	45	0	32	0	4	0	6	0	3	0

APPENDIX H

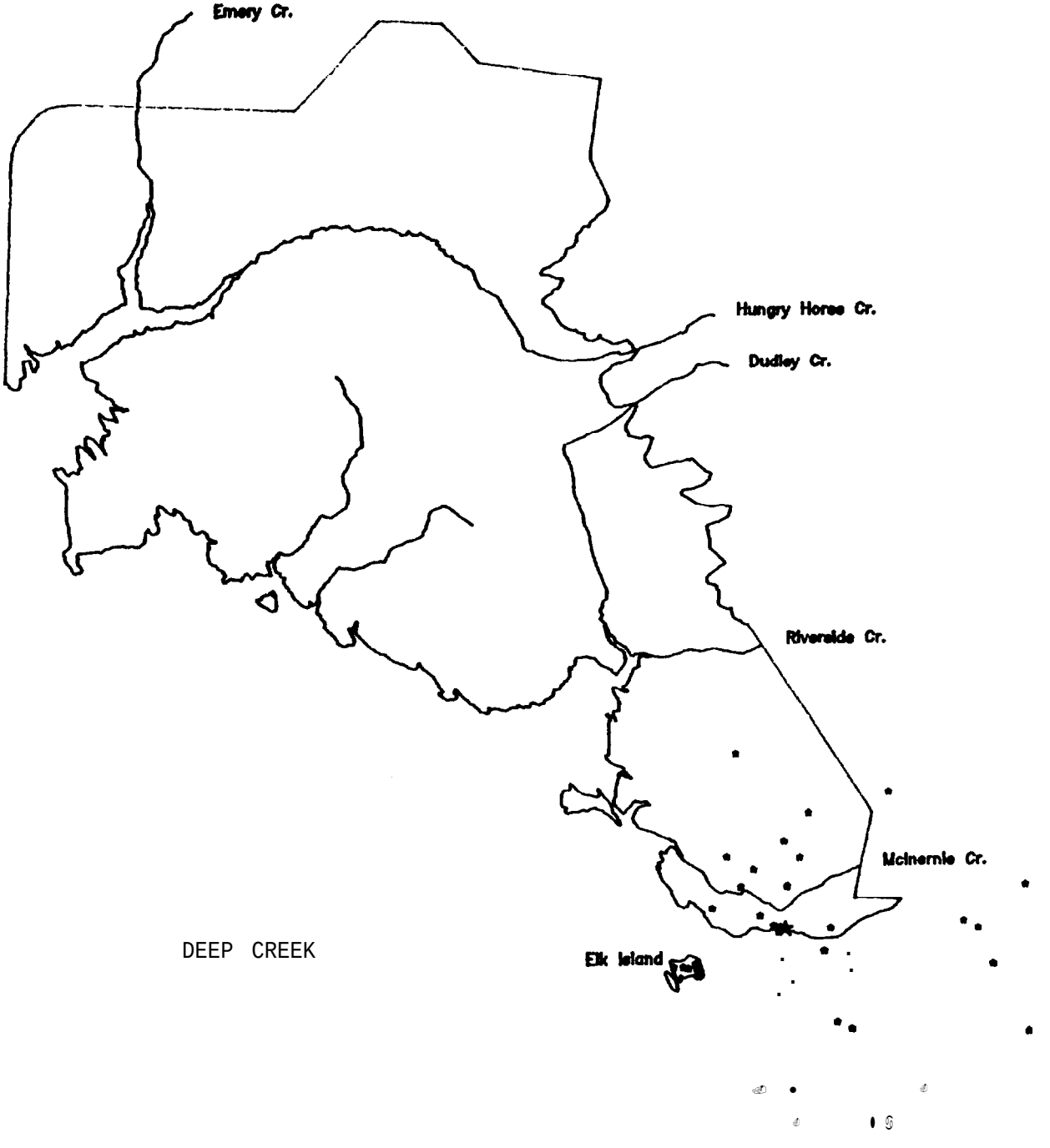
Elk radio-locations, Jan. 1988 - 15 May 1990, based on trapsite where marked, Firefighter Mountain winter range area.



FIREFIGHTER NW

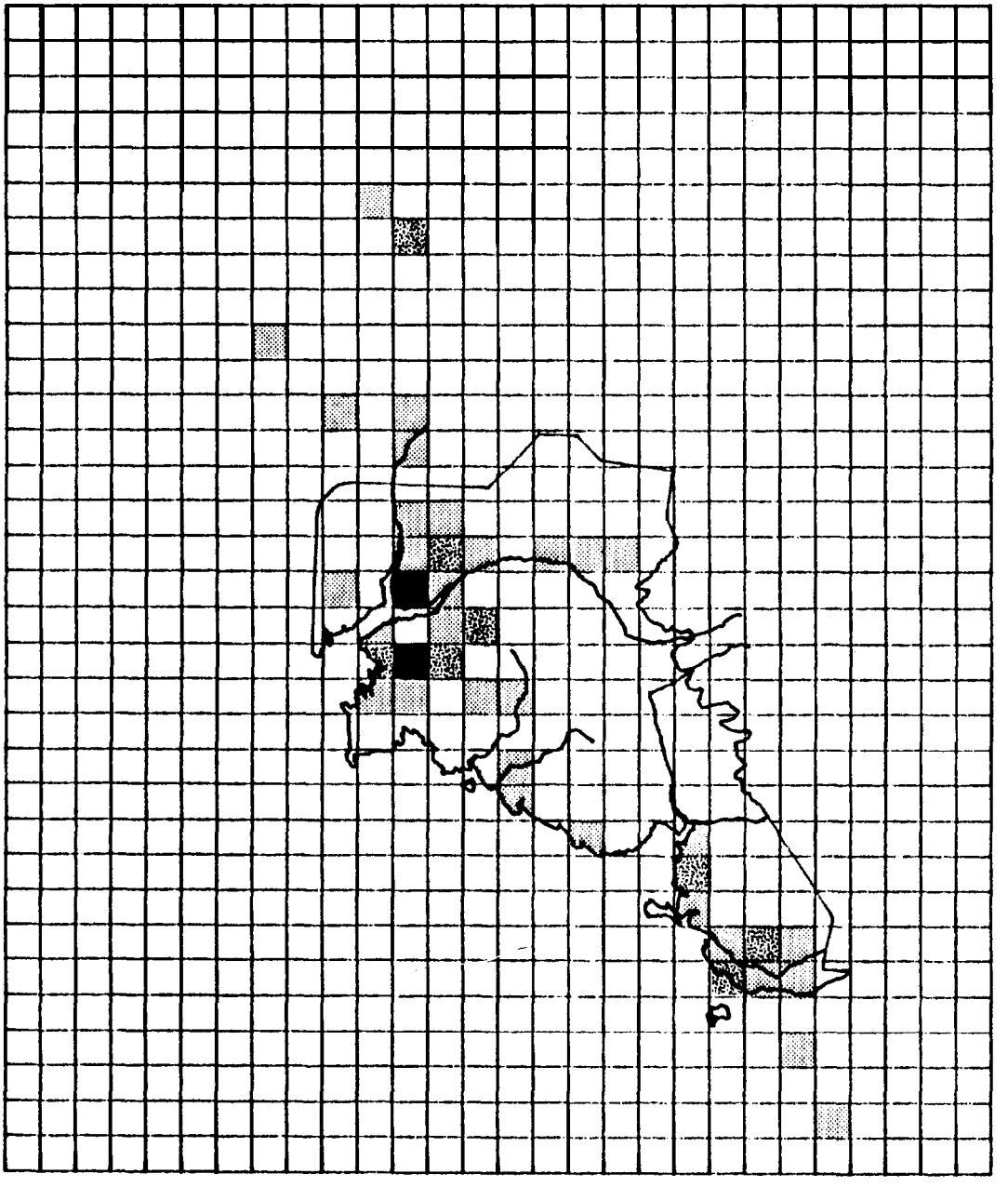
APPENDIX H

Elk radio-locations, Jan. 1988 - 15 May 1990, based on trapsite where marked, Firefighter Mountain winter range area. (cont.)



APPENDIX I

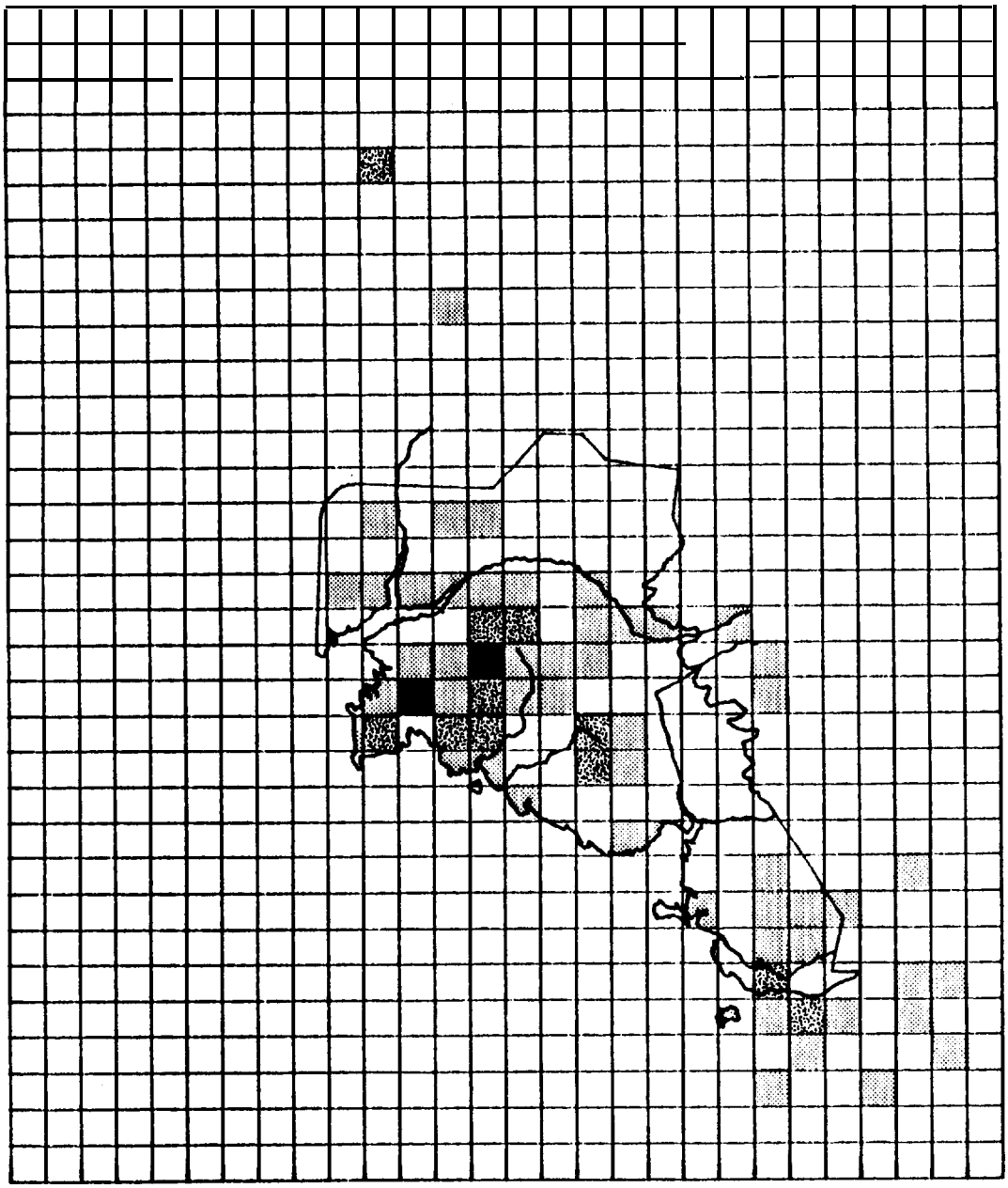
Examples of seasonal group density patterns by UTM grid, Firefighter Mountain project area.



WINTER 1988/89

APPENDIX I

Examples of seasonal group density patterns by UTM grid, Firefighter Mountain project area (continued).



N = 109 Group locations:

5
3-4
1-2

SUMMER 1989

APPENDIX J

Scientific names and species codes for browse species encountered on transects in the Firefighter and Spotted Bear winter range areas, 1988 and 1989.

Common Name	Scientific Name	Species Code
mountain maple	Acer plabrum	ACGL
Sitka alder	Alnus sinuata	ALSI
serviceberry	Amelanchier alnifolia	AMAL
creeping Oregon-grape	Berberis repens	BERE
birch	Betula spp.	BETE
redstem ceanothus	Ceanothus sanguineus	CESA
evergreen ceanothus	Ceanothus velutinus	CEVE
redstem dogwood	Cornus stolonifera	COST
hawthorn	Crataegus spp.	CRAT
ocean-spray	Holodiscus discolor	HOD1
common juniper	Juniuerus communis	JUCO
Utah honeysuckle	Lonicera utahensis	LOUT
Menziesia	Menziesia ferruginea	MEFE
Pachistima	Pachistima myrsinites	PAMY
cherry	Prunus spp.	PRUN
currant	Ribes spp.	RIBES
Rose	Rosa spp.	ROSA
thimbleberry	Rubus viflorus	RUSP
willow	Salix spp.	SALIX
elderberry	Sambucus spp.	SAMBU
Canada buffaloberry	Sheperdia canadensis	SHCA
ash	Sorbus sitchensis	SORB
white spirea	Spirea betulifolia	SPBE
common snowberry	Symphoricarpus albus	SYAL
pacific yew	Taxus brevifolia	TABR
dwarf huckleberry	Vaccinium caespitosum	VACA
blue huckleberry	Vaccinium globulare	VAGL

APPENDIX **K**

Trapping success for traps within the Firefighter Mountain and Spotted Bear winter ranges, NW Montana.

TRAPSITE	TRAP/NITE/ELK				TRAP/NITE/DEER			
	1988	1989	1990	TOTAL	1988	1989	1990	TOTAL
POLE BARN CRL	--	--	0.6	0.6		--	2.0	0.4
POLE BARN	2.3	3.0	--	2.6	4.7	4.5	--	1.6
HH MOUNTAIN	--	2.1	3.8	2.9	--	17.0	23.0	2.9
HH MTN II	--	--	2.9	2.9		--	20.0	2.9
BRUSH CR	--	3.0	3.0	3.0		6.0	12.0	3.0
DRY PARKS	3.0	--	--	3.0	12.0	--	--	3.0
CROSSOVER	3.5	--	--	3.5	14.0	--	--	3.5
ROAD 896			4.2	4.2		--	21.0	4.2
ELK ISLND OVK	--	--	4.7	4.7	--	--	14.0	4.7
HORSE RIDGE	6.0	--	--	6.0	1.7	--	--	1.3
DEEP CR	--	6.0	--	6.0		18.0	--	6.0
UPPER TWIN(*)	--	7.0	--	7.0		7.0	--	7.0
FLAT CR	--	7.0	--	7.0	--	7.0	--	7.0
FF NORTHWEST	3.8	17.0	--	7.2	19.0	17.0	--	7.2
EMERY BAY OVK	--	--	9.0	9.0		--	18.0	9.0
SPUR ROAD	14.0	9.0	--	10.7	14.0	18.0	--	10.7
MURRY CMPGD	--	--	14.0	14.0	--	--	14.0	14.0
HH CUT	17.0	--	--	17.0	17.0	--	--	17.0
DUDLEY CR(*)			17.0	17.0		--	17.0	17.0
TENT CR(*)	--	--	17.0	17.0		--	17.0	17.0
MURRAY	--	18.0	--	18.0		18.0	--	18.0
RIVERSIDE(*)	--	19.0	--	19.0	--	19.0	--	19.0